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USE OF LANDSAT DATA FOR NATURAL RESOURCES
INVESTIGATION IN THE LOWER BASIN
OF DANUBE AND DANUBE DELTA

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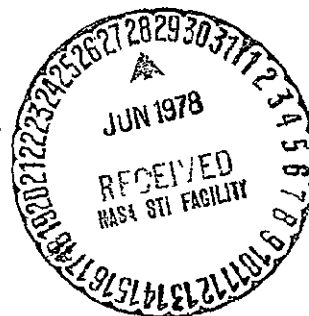
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14. Supplementary Notes We have received 94 recordings in all, under the form of negative films 6x6 cm, film positive 23x23 cm and copies on 23x23 cm paper, at a mean delay between the recording date and the receiving date of 6 months. We have also received two sets of magnetic tapes on the 15-th.02.1976 from the recordings on the 24-th - 25-th.07.1975. Six more recordings were received after the 4-th.03.1977 earthquake.		
15. Abstract: Great efforts were made and are being made for the implementation and building up of our national remote sensing program meant to meet the major requirements of our economy in the main spheres: agriculture-vegetation-soil, hydrology-oceanography, geology. Significant results have been obtained in the technological field (in spite of the unsophisticated means available and of difficulties encountered) as well as in the direct applicative field. We consider as our main achievement that one which is related to the development of a program of multidisciplinary users of Landsat data. By pointing out that the remote sensing program presents an ever increasing interest among specialists and government staff, we express our wish and intention to carry on and develop this program especially by intensified co-operation with the USA and particularly with NASA and also by joining Landsat C program. In Romania, the decision has been taken to achieve a remote sensing ground reception station as well as a data processing system, meant in the first place, for applications in agriculture, geology, hydrology-oceanography.		

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REPRODUCIBILITY OF THE
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1. Title of the investigation, area, received recordings

Title of the investigation:

"Use of Landsat data for resources investigation in the lower basin of Danube and Danube Delta /Program DaDelta/".

Agreement period: May, 1-st 1975 - November, 30-th 1976;

Actual period: November, 1-st 1975 -
November, 30-th 1976.

Established area are shown in fig.1 - about 80,000 sq.km.;

45,30 N;	25,30 E	45,30 N;	30,15 E
45,30 N;	29,45 E	43,30 N;	25,30 E

Effective covered area with recordings - fig.1;

(We are in an area at about the same latitude as Greenbelt and a little further north-continental climate).

Further details regarding precipitations, sunny days, annual and seasonal mean temperatures, plus a brief geographical description, are available.

Index map with the agreed and respectively effective covered area is given in fig.1.

Accounts of the recordings received up to the present for these stations, recurrences, connexions, are given in fig.2; all recordings existing over our country are practically acquired or ordered at Sioux Falls.

Detailed evidence of the received recordings contain:

- /a/ established and received data products (fig.3);
- /b/ the quality of the recordings, the number of the nominal pixels and respectively the actual ones, the number of the Baudot units (fig.4); the Landsat image descriptor forms are not enclosed - according to NASA recommendation;
- /c/ drifting, hour deviation among the recurrent recordings and discrepancy between the dates of receipt and recording of data (fig.5).

2. General and specific objectives of the program DaDelta are presented concisely in fig.6, and the directions of our remote sensing program with near and long-term objectives, are shown in fig.7.

Essentially, we aim at a dynamic-complex cadastre, for survey-inventory, for monitoring our resources.

Investigation approach and data handling plan are shown in fig.8

and up-to-date data handling plan in fig.9

3. Technical and organizatory achievement may be also seen in brief in the following:

- /a/ Agencies and organizations involved in the program on the basis of agreement - fig.10;
- /b/ Lectures, meeting, courses, exchanges of experience, open bibliography - fig.11;
- /c/ Publications: selected notes, remote sensing bulletins, papers, edited courses, dubbed documentary films - Fig.12;
- /d/ Facilities for those implicated in the program - fig.13;
- /e/ Acquired devices-equipment - fig.14.

3.1 The system of sampling data. In the present circumstances, taking into account the spectroradiometrical and geometrical resolution of Landsat recordings, it may be stated that our country mostly constitutes an extensive test-site (sampling polygon), in some areas even having a character of intensive test-site, remarking that some measurements must be adapted to the specificity of satellite recordings and that some measurements are necessary to be carried out simultaneously or closely linked to the time of satellite passes.

In accordance with the above, it is mentioned:

- in agriculture-forest, most of the agricultural, forest, pasture farms are organized over large plots; for example, on the greatest part of these farms the farming is performed on large plots - 1000 to 2000 meters length and 500 to 1000 meters width, - average 1500/750 meters; only in the parts with fragmented relief the plot size may be smaller;
- the conventional thematic maps and the afferent basic measurements are carried out for the scales 1:1 000 000, 1:500 000, 1:250 000, 1:200 000 and even much larger (soil maps, crop plans, geological, hydrological maps etc.); thus, the available specialized measurements must be carefully reorganized and sorted in order to meet the requirements of sampling for remote sensing.

As regards the sampling measurements necessary for the general technology of remote sensing, these must be conceived and achieved according to an adequately adapted program so as to be generally valid; the deltaic sampling system has been designed and partially carried out in this sense.

3.1.1 - Test-sites (deltaic test-site in advanced stage and the agricultural one being carried out). The specific of our design of test-sites is the selection and arrangement of profiles crossing characteristic, representative areas, taking the geomorphic structure, the nature and regime of phreatic and superficial water, the kind of vegetation into account. Along these profiles traced in the terrain, both in uniform and transition zones, niches and stations meant for measurements are used.

In fig.15 we may see track of the great deltaic profile and sea positioning. In fig.16 we see the same profile recorded aerophotographically; in fig.17-18 are given the descriptor forms for test sites Delta and Bărăgan.

- Stepwise determination are shown in fig.19.
- The basic center of deltaic determinations is Dunavăț field laboratory on the profile, as well as in the adjacent zones.
- The general situation of the test-sites is showed in fig.20, where we may notice:

- the tracks-profiles for ground and superficial water, vegetation, geologic-geomorphic structures; plots of drawing water to monitor the quality, natural and artificial tracers using stable isotopes;

- location of satellite mirrors on the drillings as well as for identification of the sample plots;

- satellite target and experimental premarkings for aerial surveys; lines and profiles for measuring temperatures, gradients.

Fig.21 presents the general situation of the Dunavăț field laboratory, as follows:

- plots with variable density ranges, useful both for Landsat 1 & 2 programs and for Landsat C - resolving power 79, respectively 30 m, for measuring transfer functions as well;

- location and presentation of the fixed aero-spatial target, complex meteorological station-fully automated, a 50 m high tower for photo and meteo recordings. From the tower, sounding balloons may be launched, special spectrometric measurements may be carried out.

The partitioning and arrangements of the Dunavăț field laboratory, consists of:

- chamber for centralized control and automated recording;
- photolab light-tables, projectors, sinoptic maps, existing recordings.

Besides the above mentioned, mobile platforms for premarking on water mirrors have been designed, a system for positioning bouys has been achieved.

The Delta test-site and Dunavăț field laboratory were conceived as a modular, flexible structure, as a technological center for data receiving and processing as well as for staff training and specializing.

- Mention must be made of the experimental measurements with Aga thermovision as well as the operative utilization of Nimbus meteo recordings.
- The determinations within the airborne chain have to the necessity of trebling the volume of aerophotographies.

3.2 Analogical data processing consists of:

- Routine photo processing - enlargements of satellite recordings on the scale 1:200 000 (scale used in drawing-up most of our thematical geological, soil, hydrological maps). These enlargements are seldom achieved on the scale 1:100 000. Here mention is also made of different electronic copying, sandwich combinations negative/positive from different bands, false stereo observation, various types of densitometry, MTF measurements;
- Photoprocessing Agfa Contour system - equidensities black & white, 1-st, 2-nd, 3-rd orders with various exposure times as well as Agfa Contour Professional with visualization obtaining toning in yellow, magenta, cyan, green and red which allow: transition from certain qualitative indices to quantitative ones, combinations color composite system, as well as some special visualization. We attempt to achieve the toning using ordinary photomaterials and also to utilize the AGA thermogram appendix for obtaining color density slicing;
- As regards quantitative assessments, we mention that our attempts of densitometry-photometry made under different variants and possibilities have not led to very satisfactory results; attempts made by direct processing of the video-information in the computer-although we could not apply atmospheric corrections nor certain systematic errors - have led to promising results (bidimensional-tridimensional histograms and "maps" through filterings) using them in sampling areas; we do not hasten to absolutize them, but they constitute a valid option, applied for the turbidity-water mixture, for biomass assessment and the

production per hectare for various reed biotops.

- Electronic processing for density slicing using I₂S device, attempting at transition from qualitative indices to quantitative ones.

3.3 Digital processing starting from CCT-s:

- After reading the CCT-s, algorithms and software were carried out for: (a) densitometering along scan lines, with the possibility of superposing 2, 3 or 4 spectral bands; (b) densitometering on shapes intersecting the scan lines, with the superposition of 2, 3 or 4 spectral bands; (c) setting up of "contrasted scan lines" by means of various algebraic combinations of the original ones: $(4-7)/(4+7)$; $(5-6)/(5+6)$; $(4-6)/(4+6)$.32; $(2.4-7)/(2.4+7)$; $(2.4-6)/(2.4+6)$; (d) printout of maps representing equidensitometry, strip and threshold filtering; (e) histogram of the grey levels distribution in a single spectral band using, as desired, both scales: linear and logarithmic; (f) histogram of the grey levels 2-dimensional distribution (simultaneous analysis in two spectral bands) respectively 3-dimensional distribution (simultaneous analysis in three spectral bands) using as desired both scales: linear and logarithmic; (g) training for the minimum distance decision rule; (h) training for the maximum likelihood decision rule; (i) classification using the minimum distance decision rule; (j) classification using the maximum likelihood decision rule; (k) before any classification we realise the identification of phenomena (clustering).
- The design and achievement of a system software for processing of the Landsat video data, are shown in fig.22; the handbook for processing and operating Landsat CCT-s is available.
- After displaying the results on the listing and after checking-up, the output-results on magnetic tapes is performed for transfer and display on the automatic drawing table, with geometrical corrections application (the Aristomat system interfaced with the C-32 Romanian computer) with adaptations of "lesing" for zones presenting particular interest.

The system also included the possibilities of transferring the data resulted from airborne and respectively field recordings to the flow of data afferent to satellite recordings: a Aristomat digitizer is able to transfer the data from airborne and field recordings to magnetic tapes, to be processed as a whole,

within the interactive, supervised, iterative process; for the moment, our system is endowed only with the output on punched band, following to be adapted for output on magnetic tapes.

- The adjustment of the conversion analogical-digital (A/D) and digital-analogical (D/A) is presented in fig.23.

3.4 Outline of our remote-sensing technological process

Under the conditions of practically disposing only of conventional equipment and devices (computers, displays, plotters, analogical-digital and digital-analogical converters, photogrammetrical equipment) a mixed system of analogical-digital processing, on successive steps was conceived and achieved, adapting ourselves to the case of limited means, at this stage.

The advantages and possibilities of the digital-processing of multispectral recordings being known and checked up they are considered and used as basic processing.

Analogical and analogical-digital processings are used as necessary chains for the convergence of the iterative steps of the process and respectively for reducing the operation time on computers to no more than necessary.

Practically:

- (a) Considering the account of the dates of Nimbus recordings proximal in time, we foresee the influence of atmospheric factors on Landsat recordings (as cloudiness) which we are to receive and we also determine elements for the application of corrections due to atmospheric parameters;
- (b) Sampling measurements are performed during or close to satellite passes; measurements are also carried out before and after these passes. Measurements on test-sites are directed towards appropriate-controllable sampling areas, both natural and man-made;
- (c) The general visual analysis of recordings is performed as well as the correlation with conventional thematic maps existing in the area, according to special domains;
- (d) Analogical and analog-digital processing is carried out:
 - Agfa Contour equidensities as well as processing with the A/D and D/A conversion system are attempted for each spectral band: band threshold filtering, equidensitometry, enhancing,

densitometerings profiles, which provide us with preliminary orientative indications regarding subsequent digital processing;

- some optic-photographic processings, generally analogical ones, are taken up again, reaching final results in some cases.

- (e) Digital processing is carried out:

- account being taken of the mentioned equidensitometric maps are set up with visual selection, by estimating the step levels (band and threshold filterings);

- superposed densitometerings in the four spectral bands in the characteristic and sampling areas;

- statistics for the sampling area: single, double, triple histograms with separation of equiphénoménon by drawing isolines;

- assignment of training sets, including testing by clustering-according to groups of sensors or individual sensors (as in some cases the difference is quite great ("sixth lines stripping"-phenomenon));

- thematic maps with classifications achieved by training the computer, obtained on the listing in black-white and colour (in the latter case the output from the computer is performed on punched tape which is then visualized on the type-writer by backplaying as many times as many colours have to be achieved);

- checking on the ground and possibly also taking up again one or several iterative cycles with final results obtained as thematic and numerical values.

The general diagram of the process is shown in fig.9.

Within the classification systems of the processing and interpretation methods of remote sensing data the above diagram ranges with the supervised, being pre, post and co-assisted by the operator: a segmentation of the whole of the measured spectra is performed, based on a priori knowledge of the investigated area, keeping a dialogue between the operator and the computer both before and especially during processing, respectively after processing.

Attempts are made to approach the processing by using data compression with the help of transform called the principal component transform (Karhunen-Loève), which operational is known under the name of transformation into multivariate categorical processing space.

Likewise, when we have the possibility of using sophisticated sys-

tem, we process the Landsat recordings made over our areas comparatively (for example at I²S, Matra, Image 100).

The limitations and difficulties of our technological process are inherent to limited means and adaptations: it has some unequal chains with respect to the system as a whole, it is rather slow and expensive.

4. INTERPRETATIONS, SIGNIFICANT RESULTS

4.1 In the field of vegetation, soil, land-use, agriculture

4.1.1 The interpretation of Landsat analogical data in different bands, has led to the following conclusions:

- The surveying and monitoring of the phenomenon excess of humidity is possible as it results from the suggestive examples in the zone of the Bărăgan test-site (fig.24). As the state of humidity and the excess of humidity may be watched during the winter-spring period, we can foresee the vegetation state of the crops at the end of the spring;
- Qualitative improvements of 20-50% have been obtained as regards soil inventory in the eastern Danube Delta, by comparison with data on conventional maps (fig.25).

4.1.2 Interpretation of Landsat colour composite images (the combination of bands 4, 5, 7 ordinarily processed) has led to interesting results in:

- Soil mapping in correlation with vegetation: colour incongruity of zones with soil coverage shown on conventional pedological maps, has raised the problem of the possible existence in the respective areals of certain features which have not been made evident on the available pedological maps; in this way satellite images bring important specifications with respect to the limitations of large pedo-geographical units, as for example in the case of Sub-Carpathian depression, of some platforms and piemonts;
- The pointing out of wind erosion (which appear as yellowish beaches unidirectionally extended) has enabled the bringing up-to-date of the respective pedological maps, finding the evolution of the phenomenon in a 10 years period, as well as the difference between the satellite and the conventional mapping (as a whole, the differences are 2.2 times as the areal determinations);
- Up-to-date and correction of pedological maps of salted soils (these areals appear on the dark-red, and the salted crusts appear

in white-pink-blue) noticing differences of 58%; moreover, in some enclosures, the separation of areals with salinization existing of the conventional pedological maps could be distinguished from the extension areals of salinization in the last 10-12 years;

- The estimation of the pedological situation which has occurred after drainage in impounded enclosures: the appearance of stagnate water can be surveyed due to difference in colour shades; the areas with gluey soils which were lake bottoms, rich in CaCO_3 , highly gluey and with shell grist being clearly presented.

4.1.3 Maps with thematic classifications obtained digitally at the computer, have proved to possess a high degree of accuracy, allowing not only the fast and quick identification of the main crops at a given moment, but also the land-use at a given moment, capable of supplying accurate enough information regarding their utilisation level: the extend to which grounds are covered by crops, the development state etc., the signalling out and delimitation of damaged zones in the wet season, the identification of areas affected by salinization etc.

In a concrete way, from the approx. 6,000 sq.km survey area, by selecting training samples only for 70% of the components of the agricultural landscape and by performing re-classification for a limited area of approx. 440 sq.km (sampling over 10% of this area) the following results have been obtained from the investigated areal: corn was accurately identified in a 95% proportion; the beet-root and soya bean crops have been taken together, being accurately classified in a 90% proportion - see fig. 26-30.

-In the deltaic zone, the achievement of a thematic mapping for 8 themes was also attempted, using the classification on training sets at Image 100 obtaining a complete map presented in fig. 30(a-o) as well as drawing out of themes fig. 30(a-h), while for the categories of wetland (marshes, pools, water bodies) 8 more drawing-outs - fig. 30(g-o) in several variants: with isolated pixels removed, respectively surrounded pixels included ones, with regions grown, outlines.

4.2 In the field of hydrology, pollution

4.2.1 The sediment discharges into the sea and the dispersion regime in the sea at the Danube mouths and out at sea at great distan-

ces, over 100 km, can be very clearly seen on Landsat MSS 4 and 5; in fig.31 we can follow the distribution of alluvial deposits concentration using relative indices of density - qualitative determinations, on the Landsat recording of the 24-th July 1975, band 5; the same distribution can be seen in the sampling area in fig.32, by means of aerial photos and field measurements; a detailing - sampling has been also performed for the inland lakes - Razelm, see fig.33.

The difference in turbidity during two successive days existing in the area of sidelap of Landsat recordings on July 24-25, 1975 (period of heavy floods) could be surveyed in relative values by adequate registration of recordings and by processings using density slicing and thematic classification on the Image 100 unit.

4.2.2 Biological pollution of coastal waters; the so called "red-blossoming" - biological pollution of coastal waters can be seen in the suggestive image in fig.34.

Our practical aim has been to establish a correlation between turbidity due to mineral suspensions in water and Landsat data. A proliferation of phytoplankton algae took place in 1975 (mainly *Exuviella cordata* - 40-80 mil./l); this phenomenon may be clearly watched on the Landsat data (18-19 June 1975) being also confirmed by airborne recordings (13 June 1975). The phenomenon began to decrease in July, fact which was confirmed on Landsat data on 24-25 July 1975.

During the cold season of 1976 a new wide-spread "red-blossoming" occurred - this time due to diatoms (*Sckeletonema* - more than 60 mil./l) which may be clearly seen on Landsat data - 26.02.1976 - bands 4 and 5.

We need Landsat data for the period 16-19.09.1975 to check them up function of the field measurements which intercepted very interesting biological aspects.

We need also Landsat data for the last period of November to check them up function of the field measurement at the peak period of the phenomenon.

The experiments performed have led to the conclusion that there are great possibilities to use remote sensing for surveying water quality; at present we cannot separate biological pollution from turbidity due to mineral suspensions.

An encouraging attempt at separating them was the Aga thermovision recordings.

We are interested in building up general-whole repetitive mosaics, sequential at convenient intervals to watch-monitor and possibly forecast the phenomenon, achieving a physical-mathematical modeling on the basis of space recordings.

Noteworthy are the interesting and valuable measurements of deuterium concentrations in water and soil humidity (having as additional parameter Δ Dens) for studying the hydrological regime in the Danube Delta and the Black Sea coastal area.

4.3 In the field of geomorphology, geology

- The successive stages of the evolution of the Danube Delta, clearly marking the separation of the fluvial delta from the marine delta, are shown in a particularly significant way on MSS bands 6 and 7, see fig.36-37.
- In order to watch beach evolution and to establish the maximum instability areas, field surveying has been performed, airborne and some correlations with space data, but repetitive space recordings over longer periods are necessary for clearing up the phenomenon.
- In this respect, on the basis of criteria applied independently by two researchers, on the same data recordings, the maps of lineation field distribution are obtained - fig.38 - which were statistically processed; this distribution has been manually digitized, separately for the whole length of linear elements in a 1 km spot (fig.39), respectively of the distribution of the intersection points (fig.40), being able to trace the equal density curves (fig.41), respectively the isolines (fig.42). Starting from the digitized map (fig.39) a band filtering has been performed in the frequency field in order to eliminate the high frequencies and the low ones, associating an exponential operator and thus the residual map of the lineation density has been obtained (fig.43).

Previously we also achieved a statistical analysis of the total lineation field, considering the directions, the relative importance of the lineation tendencies and respectively the distribution of the lineation density, obtaining the distribution in fig.44-45.

By achieving correlations with tectonic, metalgenetic, aeromagnetic, gravimetric maps, the following has resulted:

- About 40 percent of the linear elements identified in the remote sensing recordings are easily discerned and may be drawn with entire impartiality; they may be compared without difficulty to the known geological data;
- About 30 percent are not shown on the conventional maps, but there are arguments that they are in accordance with the structural tendencies. They yield interesting explanations and may suggest new hypotheses which are to be checked up in the field;
- The rest of 30 percent are not in agreement with the present geological data and cannot be explained at the present stage of knowledge; many of them probably have not geological basis.

The geological information which can be interpreted on satellite recordings have contributed to:

- the outlining of areals indicating the possible presence of polymetallic mineralisation;
- the outlining of perspective perimeters for thermal waters accumulations;
- the supplementation of the image as a whole concerning the geological structure of the investigated territory; the map drawn up on remote sensing data supplies new research assumptions viewpoints.

These findings have contributed to the judicious location of prospecting and exploration, at the same time representing possibilities of comparing-checking up satellite interpretations.

Field investigation are being carried on.

Finally, presented concisely in correlation with the set objectives, the following significant results are to be mentioned:

- We have laid the foundation of our own remote sensing system on the basis of field, airborne and Landsat data, by developing a multidisciplinary investigation, involving organizations and specialists from various domains, coming up against the difficulties and limitations inherent for the beginning;
- We have conceived and adapted certain analogical and digital technologies for data processing;
- We have obtained results in the direction of the specific set objectives, the tasks and objectives to be pursued in the near and further standing out quite precisely; the lines of development

in this field are clearly established;

- We have attempted to present our achievements by underlining certain of the characteristics specific for the remote sensing system we have undertaken.

Technical remarks:

- The fact that the fundamental analysis of multispectral data must be digital, is confirmed;

- Obtaining suitable results within the supervised processing, co-assisted by the operator, is conditioned by the quality of the training sets; hence the field investigation must be characterized by thoroughness and minuteness, both from the viewpoint of the identification of the phenomenon and the accuracy of location; as a rule, this implies multidisciplinary studies;

- We are interested in remote sensing mainly for monitoring of phenomena and objects, with a view to achieving dynamic evolution models, necessary for forecasting on shorter and longer periods; for crops, pollution, water storage in the soil, humidity excess, spring inrushes, floods, cloggings;

- In accordance with the above mentioned, a data stock with sampling value, organized under the form as a data bank must be achieved in order to allow the detection of changes in a operative way; field and airborne data diminish to the necessary minimum;

- It is found that even in the case of existence of intensive conventional measurements, remote sensing ensures a synoptic view at regional scale (as no other data source has ever offered it before) particularly useful, allowing the detection of subtle differences between large field structures;

- Likewise, remote sensing offers the possibility of studying even relatively limited zones, over which a great number of phenomena and their ways of manifestation make themselves evident;

- Field investigations for comparison-checking up are being carried on for most of the results of the interpretations mentioned in this report.

5. Major problems encountered during the course of investigation; conclusions, suggestions

- The delay in receiving the recordings;

- We need some reference material - mostly from NASA Landsat Newsletter:
- the paper "Digital image rectification/ registration system (DIRS) software tapes", by Peter Van Wie and Maurice Stein (NASA Landsat Newsletter nr.10/August,1,1976);
 - the reports in connexion with the GSFC Information Transfer Laboratory (Intralab) - (NASA Landsat Newsletter nr.11/Oct.1976);
 - the report summarizing the results of the NASA P.I. panels - October, 1976 (NASA Landsat Newsletter nr.12/Dec.,1,1976);
 - the new publication "The Satellite Data Collection Newsletter" (NASA Landsat Newsletter nr.14/April,1,1977);
 - the HCM Data Users Bulletin (NASA Landsat Newsletter nr.14/April,1,1977);
 - the report in connection with AOIPS Water Resources Data Management System (NASA Landsat Newsletter nr.14/April,1,1977 and NASA Landsat Newsletter nr.16/August,1,1977);
 - the study "Discrimination of Rock and Soil Types by Digital Analysis of Landsat Data" by M.H.Podwysocki and H.W.Blodget (NASA Landsat Newsletter nr.14/April,1,1977);
 - "Summary Tables for selected digital image processing systems" by Virginia Carter, F.Billingsley, J.Lamar (NASA Landsat Newsletter nr.15/June,1,1977);
 - "Additional technical information about the radiometric calibration of Landsat 2 video data" (NASA Landsat Newsletter Nr.15/June,1,1977);
 - The 5 supplemental pages to be added to the Appendix H to the "Generation and physical characteristics of the Landsat 1 & 2 MSS-CCTs" (NASA Landsat Newsletter nr.16/August,1,1977);
 - Nimbus-G Data Users Bulletin (NASA Landsat Newsletter nr.16/August,1,1977).

All the above - mentioned material is offered on request, as specified in NASA Landsat Newsletter.

Conclusions:

We underline that the remote sensing program enjoys an ever greater interest within a large range of specialists in various domains of activity and government staff. We express our wish and intention to continue and further develop this program: by improving co-operation with USA and NASA especially, by joining

Landsat C program (our answer to the NASA notice regarding this program is included in the appendix), by efforts for the acquisition of apparatus and materials, for the training and specializing of qualified staff.

In Romania, the decision has been taken to achieve a remote sensing ground reception station as well as a data processing system, meant in the first place, for applications in agriculture, geology, hydrology-oceanography.

We are persuaded that only now we actually start the investigation work for the essential turning to account of data, because at present we have the recordings, the organizatory and material background necessary for program development, being resolute to make our contribution to building up the operational remote sensing, to evolve the development research.

Last but not least, acknowledgements to all who did their best for the development of our remote sensing program both in our country and in the States as well.

List of figures, slides and appendices

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- Fig.25 Interpretation of Landsat recording (band 7) for soil inventory in the eastern part of the Danube Delta: 20-50% qualitative improvements have been obtained in comparison with data on conventional map
- Fig.26 Densitometering profiles along scan lines in 4 spectral bands, correlated with soil-relief
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- Fig.30 Thematic mapping at Image 100 obtained in several variants (a-o) respectively for different themes unsupervised
- Fig.31 The distribution of alluvial deposits concentration using relative indices of density - qualitative determinations, on the recording of the 24-th July 1975, band 5
- Fig.32 The same distribution followed in the sampling area by means of airphotos and field determinations
- Fig.33 A detailed sample achieved for inland lakes
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- Fig.35 Biological pollution occurred in cold season (Landsat data 26.02.1975, bands 4 and 5)
- Fig.36, 37 The recordings show the successive stages of the evolution of the Danube Delta, clearly marking the separation of the fluvial delta form the marine delta; thematic mapping on the basis of MSS
- Fig.38 The maps of lineation field distribution obtained on the basis of criteria applied independently by two researchers, on the same Landsat data
- Fig.39 The maps of lineation field distribution manually digitized
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- Fig.42 Residual map of lineament, obtained by Fourier frequency filtration
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- Appendix 1 List of publications, documentation a.s.o. we are need of
- Appendix 2 Response to the NASA applications notice - AN-OA-76-B
- Appendix 3 Summary of the 11 Remote Sensing Bulletins.
- Appendix 4 Index map - recordings over Romania - EROS Center 1972-76; 76-77
- Fucino 1975-1977

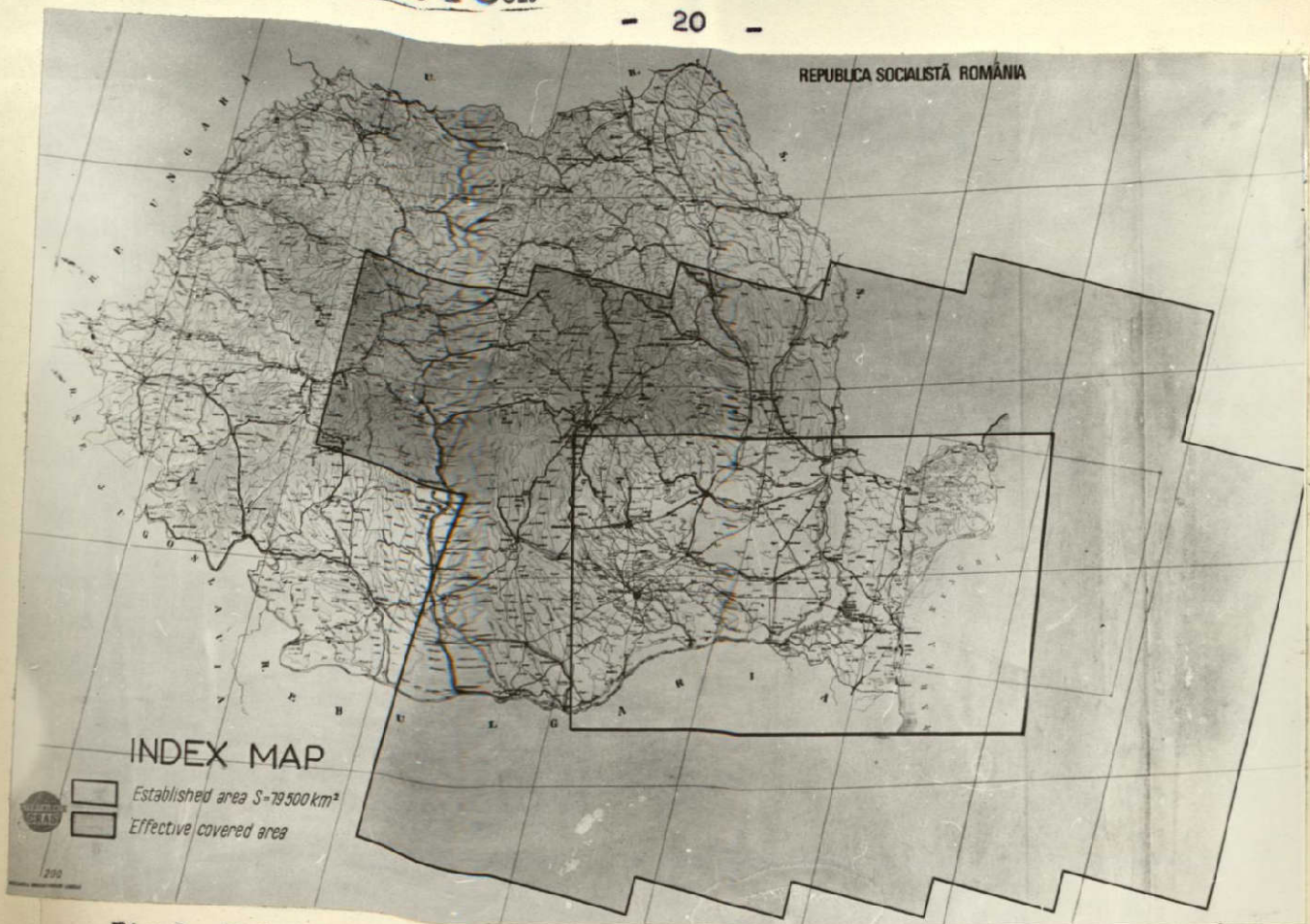


Fig.1 Index map with the agreed and respectively effective covered area

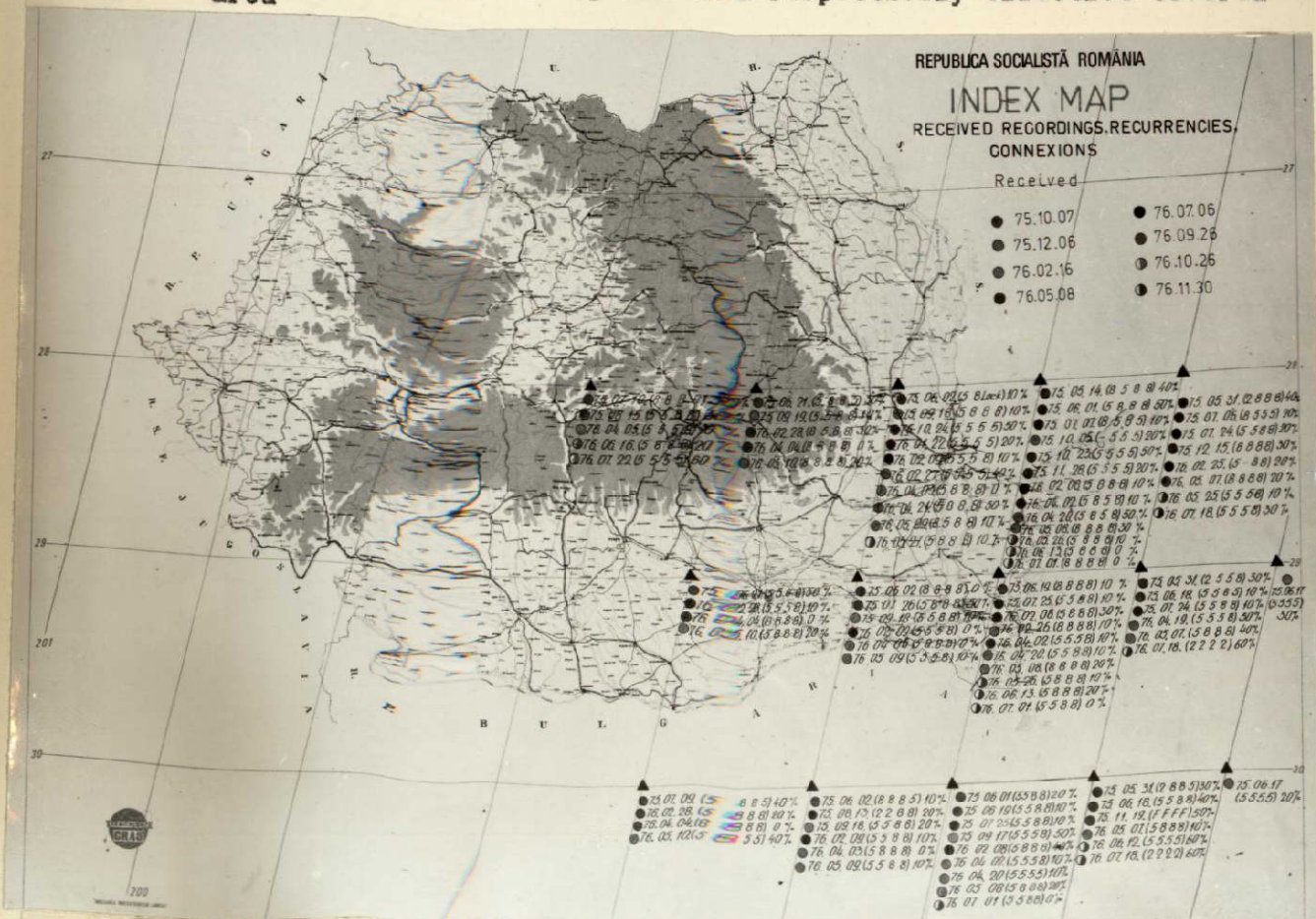


Fig.2 Index map: received recordings, recurrences, connexions

Fig. 4

Quantity and quality of the received data

Number of recordings	Of which			Number of pixels		Number of Baudot units	
	2	5	8	Nominal	Actual	Nominal	Actual
372	17	161	194	2.84×10^9	2.19×10^9	4.1×10^{13}	3.16×10^{13}

Fig. 10

Agencies and organizations involved in the program
on the basis of agreement

1. Laboratory for Remote Sensing - College for Civil Engineering Bucharest
2. Institute of Meteorology and Hydrology
3. Institute of Research and Design for Land Improving
4. Institute of Geology and Geophysics
5. Institute of Soils - Academy of Science
6. Romanian Institute of Marine Research - Constantza
7. Institute of the Danube Delta Research - Tulcea
8. Institute of Geodesy, Photogrammetry, Cartography and Land planning
9. Institute for Water Management
10. Politechnical Institute - Department of applied electronics
11. Institute for Nuclear Physics
12. Institute for Telecommunications

Sponsoring agency:

National Council for Science and Technology - Romanian
Commission for Space Activities

Fig.5

Quantity-quality, hour deviation, drifting-compared
to average; delay in receiving

Index	Date	ID Number	Quality	Cloud cover %	Δt	Δp		Received	Delay Month
						$\Delta \varphi$	$\Delta \lambda$		
193/29	75.06.17	82146-08015	5 5 5 5	30	-	-	-	76.02.16	8
193/30	75.06.17	82146-08021	5 5 5 5	20	-	-	-	76.09.26	8
194/28	75.05.31	82129-08070	2 8 8 8	40	+2.5	+0.07	-0.04	76.02.16	8.5
	75.07.06	82165-08070	8 5 5 5	20	+2.5	+0.05	-0.05	76.02.16	7
	75.07.24	82183-08065	5 5 8 8	20	+2.4	+0.16	0	75.10.27	3
	75.12.15	82327-08045	8 8 8 8	30	+0.4	+0.18	+0.04	76.02.16	2.5
	76.02.25	82399-08035	5 5 - 8	20	-0.2	+0.05	-0.08	76.05.08	3
	76.05.07	82471-08014	8 8 8 8	20	-2.3	+0.13	0	76.09.26	4.5
	76.05.25	82489-08011	5 5 5 8	10	-3.0	+0.07	-0.03	76.10.26	5
	76.07.18	82543-07595	5 5 5 8	30	-4.2	+0.05	-0.01	76.11.30	4.5
194/29	75.05.31	82129-08072	2 5 5 8	30	+3.0	-0.06	-0.01	76.02.16	8.5
	75.06.18	82147-08073	5 5 8 5	10	+3.1	+0.02	-0.02	76.02.16	8
	75.07.24	82183-08071	5 5 8 8	10	+2.4	+0.13	+0.03	75.10.27	3
	76.04.19	82453-08023	5 5 5 8	50	-2.0	+0.16	+0.05	76.09.26	5
	76.05.07	82471-08020	5 8 8 8	40	-2.3	+0.09	+0.02	76.09.26	4.5
	76.07.18	82543-08001	2 2 2 2	60	-4.2	+0.04	+0.06	76.11.30	4.5
194/30	75.05.31	82129-08075	2 8 8 5	30	+3.2	-0.09	-0.04	76.02.16	7.5
	75.06.18	82147-08080	5 5 8 8	40	+3.3	-0.01	-0.05	76.02.16	8
	75.11.09	82291-08061	F F F F	50	+1.4	+0.04	+0.01	76.02.16	4
	76.05.07	82471-08023	5 8 8 8	10	-2.0	+0.05	-0.01	76.09.26	2.5
	76.06.12	82507-08013	5 5 5 5	60	-3.0	+0.03	-0.02	76.10.26	4.5
	76.07.18	82543-08004	2 2 2 2	60	-3.5	+0.04	+0.01	76.11.30	4.5
195/28	75.05.14	82112-08183	8 5 8 8	40	+8.1	0	-0.01	76.02.16	9
	75.06.01	82130-08124	5 8 8 8	50	+2.2	-0.06	-0.08	76.02.16	8.5
	75.07.07	82166-08125	8 5 8 5	10	+2.3	+0.09	-0.07	76.02.16	7.5
	75.10.05	82256-08113	- 5 5 5	50	+1.1	+0.01	-0.02	75.12.06	4
	75.10.23	82274-08111	5 5 5 5	50	+0.5	+0.06	-0.01	76.02.16	3.5
	75.11.28	82310-08105	5 5 5 5	20	+0.3	+0.16	+0.02	76.02.16	3.5
	76.02.08	82382-08100	5 5 8 8	10	-0.2	-0.08	-0.14	76.05.08	3
	76.04.02	82436-08082	5 8 5 8	10	-2.0	+0.15	-0.03	76.07.06	3
	76.04.20	82454-08075	5 8 5 8	50	-2.3	+0.21	0	76.09.26	5
	76.05.08	82472-08072	8 8 8 8	30	-3.0	+0.14	-0.01	76.09.26	4.5
	76.05.26	82490-08065	5 8 8 8	10	-3.3	0	-0.07	76.10.26	5
	76.06.13	82508-08063	5 8 8 8	0	-3.5	+0.03	-0.10	76.10.26	4.5
	76.07.01	82526-08060	8 8 8 8	0	-4.2	+0.02	-0.05	76.11.30	5
195/29	75.06.19	82148-08132	8 8 8 8	10	+4.1	0	-0.06	76.02.16	7.5
	75.07.25	82184-08125	5 5 8 8	10	+3.4	+0.12	0	75.10.27	3
	76.02.08	82382-08102	5 8 8 8	30	+1.1	-0.11	-0.12	76.05.08	3
	76.02.26	82400-08095	8 8 8 8	10	+0.4	0	-0.11	76.09.26	7
	76.04.02	82436-08085	5 5 5 8	10	-0.2	+0.12	-0.01	76.07.06	3
	76.04.20	82454-08081	5 5 8 8	10	-1.0	+0.17	+0.02	76.09.26	5
	76.05.08	82472-08074	8 8 8 8	20	-1.3	+0.11	+0.02	76.09.26	4.5
	76.05.26	82490-08072	5 8 8 8	10	-1.5	+0.02	-0.04	76.10.26	5
	76.06.13	82508-08065	5 8 8 8	20	-2.2	-0.02	+0.01	76.10.26	4.5
	76.07.01	82526-08062	5 5 8 8	0	-2.5	-0.02	+0.02	76.11.30	5

Index	Date	ID Number	Quality	Cloud cover %	Δt	Δp		Received	Delay Months
						$\Delta \varphi$	$\Delta \lambda$		
195/30	75.06.01	82130-08133	5 5 8 8	20	+2.5	-0.11	-0.01	76.02.16	8.5
	75.06.19	82148-08134	5 5 8 8	10	+3.0	-0.03	-0.02	76.02.16	8
	75.07.25	82184-08132	5 5 8 8	10	+2.4	+0.09	+0.04	75.10.27	3
	75.09.17	82238-08122	5 5 5 3	50	+1.4	-0.02	+0.05	75.12.06	1.5
	76.02.08	82302-08105	5 8 8 8	40	+0.1	-0.14	-0.08	76.05.08	3
	76.04.02	82436-08091	5 5 5 8	10	-1.3	+0.08	+0.03	76.09.26	5.5
	76.04.20	82454-08084	5 5 5 5	10	-2.0	+0.14	+0.06	76.09.26	5
	76.05.08	82472-08081	5 8 8 8	20	-2.3	+0.08	+0.03	76.09.26	4.5
	76.07.01	82526-08065	5 5 8 8	0	-3.5	-0.01	+0.05	76.11.30	5
196/28	75.06.02	82131-08183	5 8 Lack	10	+3.1	-0.05	-0.04	76.02.16	8.5
	75.09.18	82239-08172	5 8 8 8	10	+2.0	+0.01	+0.03	75.12.06	2.5
	75.10.24	82275-08170	5 5 5 5	50	+1.4	+0.05	+0.02	76.02.16	3.5
	76.01.22	82365-08160	5 5 5 5	20	+0.4	+0.04	-0.05	76.05.08	4
	76.02.09	82383-08154	5 5 5 8	10	+0.2	-0.08	-0.11	76.05.08	3
	76.02.27	82401-08151	5 5 5 5	40	-0.1	+0.01	-0.07	76.09.26	7
	76.04.03	82437-08140	5 8 8 8	0	-1.2	+0.16	0	76.09.26	5.5
	76.04.21	82455-08133	5 8 8 8	50	-1.5	+0.15	0	76.09.26	5
196/29	75.06.02	82131-08185	8 8 8 8	0	+2.2	-0.08	-0.07	76.02.16	8.5
	75.07.26	82185-08184	5 8 8 8	50	+2.1	+0.15	-0.01	75.12.06	4
	75.09.18	82239-08174	5 5 8 8	10	+1.1	-0.01	-0.01	75.12.06	2.5
	76.02.09	82383-08161	5 5 5 8	0	-0.2	-0.11	-0.14	76.05.08	3.0
	76.04.03	82437-08143	5 8 8 8	0	-2.0	+0.13	-0.04	76.09.26	5.5
	76.05.09	82473-08133	5 5 5 8	10	-3.0	+0.08	-0.04	76.09.26	4.5
196/30	75.06.02	82131-08192	8 8 8 5	10	+2.5	-0.11	-0.04	76.02.16	8.5
	75.08.13	82203-08183	2 2 8 8	20	+2.0	+0.09	+0.06	76.10.27	2.5
	75.09.18	82239-08181	5 5 8 8	20	+1.4	-0.04	+0.02	75.12.06	1.5
	76.02.09	82383-08163	5 5 8 8	10	0	-0.14	-0.11	76.05.08	3
	76.04.03	82437-08145	5 8 8 8	0	+1.4	+0.09	-0.01	76.09.26	5.5
	76.05.09	82473-08135	5 5 8 8	10	+2.4	+0.05	-0.01	76.09.26	4.5
197/28	75.06.21	82150-08242	5 8 8 5	30	+2.0	+0.02	-0.08	76.02.16	8
	76.09.19	82240-08230	5 5 8 8	10	+1.4	+0.04	+0.01	75.12.06	4.5
	76.02.28	82402-08205	8 5 8 8	30	-0.3	+0.02	-0.08	76.07.06	4
	76.04.04	82438-08195	8 8 8 8	0	-1.3	+0.14	-0.03	76.07.06	3
	76.05.10	82474-08184	8 8 8 8	20	-2.4	+0.14	-0.02	76.09.26	4.5
197/29	75.06.21	82150-08245	5 5 8 8	50	+3.3	-0.01	-0.06	76.02.16	7.5
	76.02.28	82402-08212	5 5 5 8	10	0	0	-0.06	76.07.06	4
	76.04.04	82438-08201	8 8 8 8	0	-1.1	+0.10	0	76.07.06	3
	76.05.10	82474-08191	5 8 8 8	20	-2.1	+0.10	-0.01	76.09.26	4.5
197/30	75.07.09	82168-08251	5 8 8 5	40	+3.3	-0.01	-0.07	76.02.16	7
	76.02.28	82402-08214	5 8 8 8	20	0	-0.02	-0.08	76.07.06	4
	76.04.04	82438-08204	8 8 8 8	0	-1.0	+0.07	-0.03	76.07.06	3
	76.05.10	82474-08193	5 8 5 5	40	-2.1	+0.07	-0.02	76.09.26	4.5
198/28	75.07.10	82169-08300	8 8 8 8	30	+3.1	+0.13	-	76.02.16	7
	75.08.15	82205-08290	5 5 8 8	30	+2.1	+0.16	-	75.10.27	2
	76.04.05	82439-08253	5 5 5 8	0	-1.2	+0.14	-	76.09.26	5.5
	75.06.16	82511-08234	5 8 8 8	20	-2.3	+0.02	-	76.10.26	4.5
	76.07.22	82547-08223	5 5 5 5	60	-3.4	+0.01	-	76.11.30	4

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Fig.6

General and specific objectives of the program DaDelta

General: To conduct a multidisciplinary study of land use, land use planning and natural resources inventory and development with the aim of determining the utility of Landsat type data;

To employ Landsat 2 and airborne data in selected test areas on an operational basis to monitor and inventory natural resources;

To develop an informed cadre of environmentalists, planners and other officials, who through proper training and exposure will gain an appreciation of what an improved and valuable earth resources program can achieve.

- Specific:
1. Select field areas and establish methods for obtaining ground truth information which will be used in conjunction with Landsat 2 data;
 2. Use Landsat airborne and ground truth data to develop classification overlays - thematic maps;
 3. To study coastal beach areas and determine zone of maximum instability;
 4. To determine the direction and the dispersion of alluvial sediments in the sea;
 5. To study the interaction between fresh and salt water in coastal lakes and estuaries;
 6. To obtain a quantitative estimate of natural resources (such as reed, macerred, etc.);
 7. To conduct geological studies;
 8. To conduct an experiment in phenology.

Fig.7

The directions of our remote sensing program

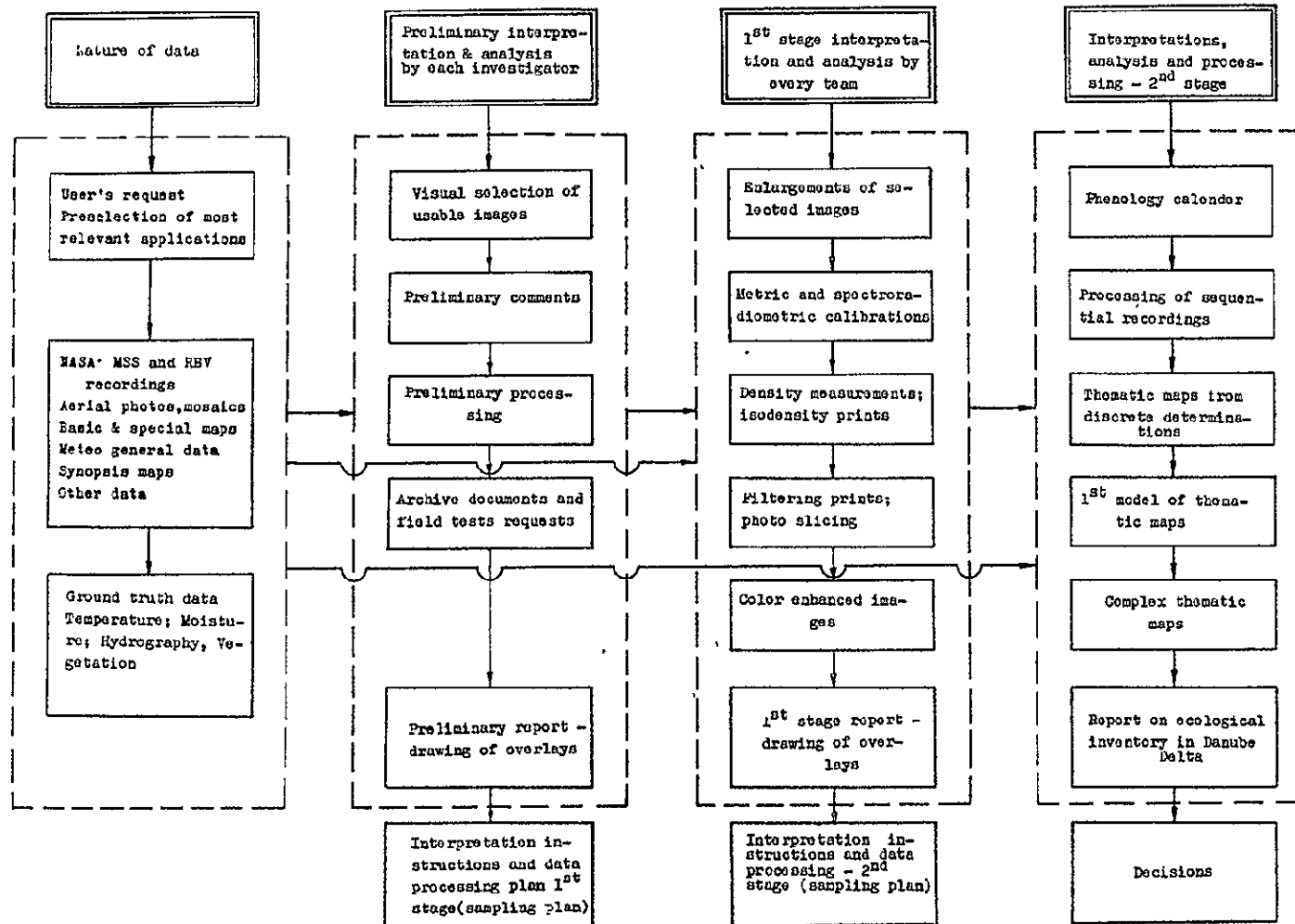
1. General technology in connection with all stages of the remote sensing, from the receiving station to complex turning to account of data, staff training and specializing, up to data documentation.

2. Operational utilizations: surveying and monitoring land fund; monitoring irrigated areas, crops forecasting; deltaic zones, continental platforms, oceanography, geological investigations-ground water, geothermal zones.

Complex program: surveying and monitoring our hydroenergetic-hydrorreclamation national system.

Fig.8

DATA HANDLING PLAN



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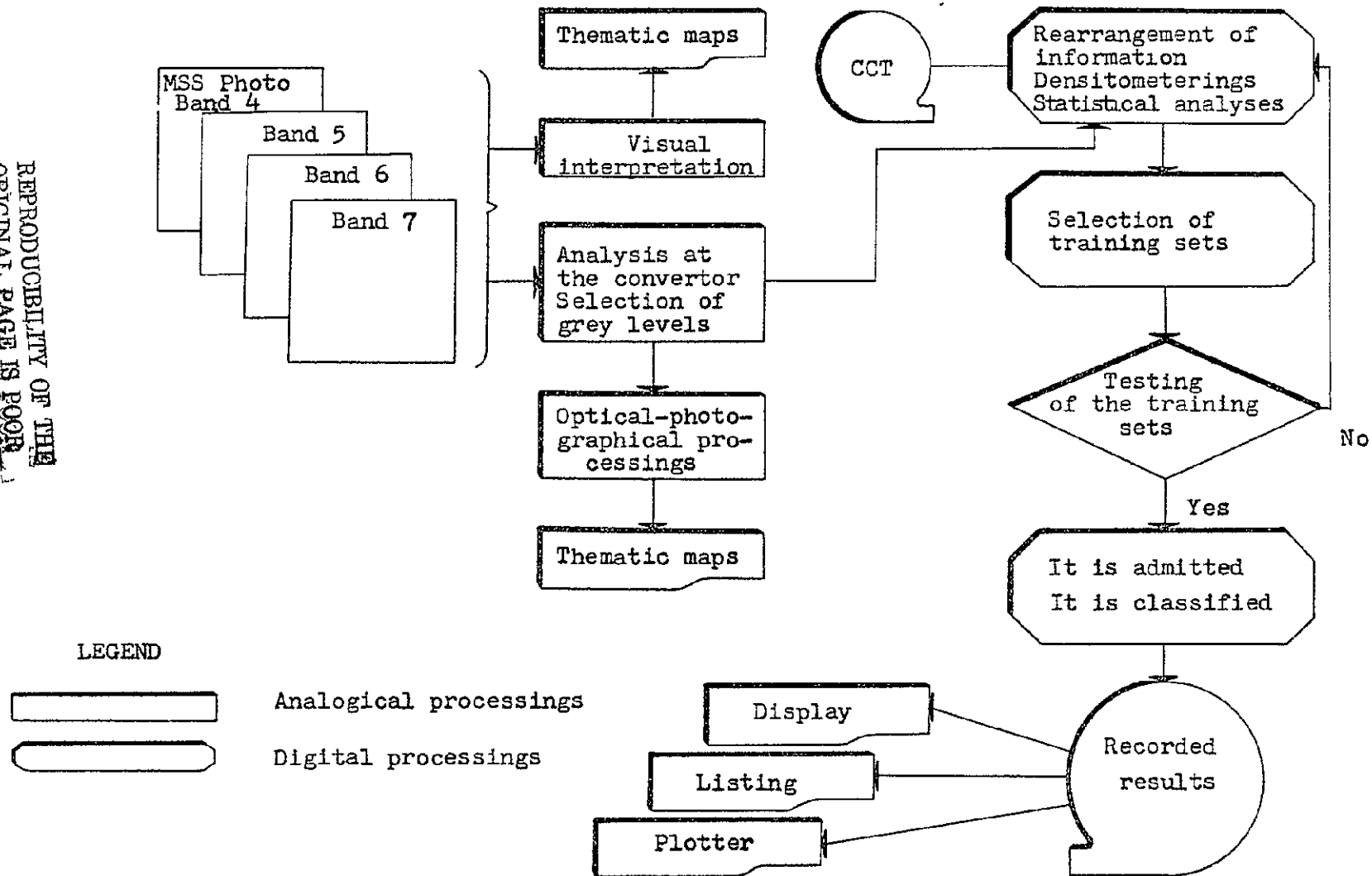


Fig.9 General diagram of the adopted technological process of remote sensing

Fig.11

Lectures, meetings, courses, exchanges of
experience, open bibliography

- 12 lectures of general character, with film projection "A long view - ERTS" - NASA and "The world of invisible color" - Bendix;
- Annual meetings and trimestrial and semestrial reports with the specialists involved in the program; idem annual meetings for launching the investigation program for the coming year;
- Conferences and discussions with M.Baumgardner - Purdue University, W.Stoney - NASA, W.Nordberg - NASA, with UNESCO delegates for the deltaic areas;
- Participation in the XIII-th International Congress of the Society of Photogrammetry, Helsinki 1976;
- Attendance to initiation course - EROS Data Center - Sioux Falls;
- Attendance at U.N. seminars: Canada (Guelph), U.Kingdom (Reading) and W. Germany (Lengries);
- Remote sensing course delivered to last-year students of Surveying&Mapping Department - College for Civil Engineering;
- Centralized library, files with significant bibliography, abstracts - summaries, remote sensing bulletins.

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Fig.12

Publications - papers

1. Technical proposal "Use of ERTS-Landsat Data for resources investigation in the Danube Delta and the coastal sedimentation /Program DaDelta/" - 1974;
2. Instructions for the preparation of proposals for investigations using data from Earth Resources Technology Satellite" Bucharest - 1974;
3. Selective documentary note-book - nr.2 - February 1975;
4. Selective documentary note-book - nr.3 - May 1975;
5. Landsat Data Users Handbook - July 1975;
6. Landsat Data Users Handbook - second edition -January 1977;
7. Type 1 Report; Progress Report for period May-December 1975;
8. Type 1 Report; Progress Report for period Jan-March 1976;
9. Type 1 Report; Progress Report for period April-June 1976
10. Type 1 Report; Progress Report for period July-Sep.1976
11. Type 1 Report; Recapitulative progress Report for period May,1975 - November,1976;
12. Remote Sensing Bulletin nr.1 - November, 1975;
13. Remote Sensing Bulletin nr.2 - December, 1975;
14. Remote Sensing Bulletin nr.3 - March, 1976;
15. Remote Sensing Bulletin nr.4 - April-June, 1976
16. Remote Sensing Bulletin nr.5 - July-September, 1976;
17. Remote Sensing Bulletin nr.6 - October-December, 1976;
18. Liste of Landsat 2 P.I.; titles and abstracts of their respective themes; June 1976;
19. Manual of Remote Sensing - Chapter 3 - Test-Sites; July-August, 1976;
20. Generation and physical characteristics of Landsat 1 and 2 MSS Computer compatible tapes; October, 1976;
21. On the optimization of the Photo-Interpretation-Remote Sensing Processes and their Applications in the Wetlands - the Danube Delta; paper - Proceedings Symposium on Remote Sensing and Photo-Interpretation - Banff, 1974;
22. Some Possibilities -for operational Calibration of the Photo-Interpretation - Remote Sensing Data; Some Application in the Wetlands - the Danube Delta; Proceedings Symposium on Remote Sensing and Photo-Interpretation - Banff, Alberta, Canada, 1974;

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23. Quelques observations et suggestions concernant la télé-détection; quelques réalisations dans le spécifique des zones humides-deltaïques; Proceedings, XIII Congress of the International Society of Photogrammetry, Helsinki 1976;
24. Establishment of the hydro-morphometric characteristics for water bodies, using photogrammetric and remote-sensing recordings; Proceedings, XIII Congress of the International Society of Photogrammetry, Helsinki, 1976.
25. Handbook for operating and using Landsat CCTs, Jan. 1977

List of reports worked out during 1976 by the collaborators involved in the programme "Inventory and discovery of new resources through remote sensing"

1. Study on the use of the remote sensing in the research of underground waters and the interpretation of airphoto and the satellite recordings (Laboratory underground water).
2. The hydrothermic regime of the soil for the main crops in the western and southern areas of the country (Laboratory of agrometeorological research).
3. Research by remote sensing concerning morphometric and dynamic characteristics of the lakes and minor and major river beds (Meteo and hydrological institute).
4. Control of the water quality by remote sensing methods (Laboratory for water quality).
5. Contribution to the hydrogeologic study of the underground waters in the Danube Delta and in the Black Sea area by remote sensing method (Institute for reclamation works).
6. Digital processing of recordings obtained by remote sensing (Nuclear and electronic department).
7. Detector assembling testing Si(Li) and cooled preamplifier and spectrometric chain variants (Nuclear and electronic department).
8. Studies and trials on the recordings at medium-small height and of field - within remote sensing (Surveying and mapping institute).
9. Research on remote sensing application under the geological condition in our country for the discovery and utilization of geothermal areas and for the prospecting of useful minerals (Laboratory of electrometric and geothermic research).
10. Technology for processing the remote sensing recordings (Laboratory for remote sensing)
11. Snow survey and monitoring with Landsat data (Meteo and hydrological institute).
12. Investigation of surface-phreatic and underground water using De concentration measurements (Nuclear and electronic department).
13. Use of Landsat data for surveying and monitoring land funds, soils and irrigated areas; crop forecasting (Academy of science).

Fig. 14

Devices - equipment available for those involved in
the remote sensing program

- Equiped aircrafts and helicopters;
- VEB Carl Zeiss Jena interptoscopes with watching and enlargement capabilities up to 20x;
- Transfer units; camera clara, pantographs, photo-rectifiers;
- Equipment for photographic reproduction and enlargement for sizes up to 100x100 cm; duplicating devices with electronic compensation;
- Stereoscopes, lenses, light-tables;
- Specialized photo-lab;
- Card - readers; access to computers, interfaced with automatic drafting table;
- Density slicing copying, Agfa contour equidensities B&W and professional colour respectively;
- Stereo-plotting instruments 1-st - 3-th orders;
- AGA thermovision with blackbody reference;
- Densimeter, photometer, spectrophotometer;
- Test-sites; space targets.

Fig. 13

Facilities for those implicated in the program

- Meteo synoptic maps and Nimbus recordings which were enlarged up to 1:3,369,000 scale;
- Copies from negatives 7x7 cm on photographic paper at the scale 1:1,000,000;
- Sometimes copies enlarged up to 1:200,000 or seldom 1:100,000;
- Copy dias from the negatives 7x7 cm up to 1:500,000;
- Copies from CCTs;
- Specialized thematic maps: hydro, geology, geomorphology, soils;
- Aerial-photographies, photo-maps;
- Equidensities Agfa Contour and Agfa Contour Professional;
- Samples of interpretation, densitometerings, interptoscopes;
- Papers, documentation, bulletins of remote sensing, a.s.o.;
- Measurements on the test-sites; specialized measurements;
- AGA thermovision recordings.



Fig.15 The track of the "great delta profile" and sea positioning

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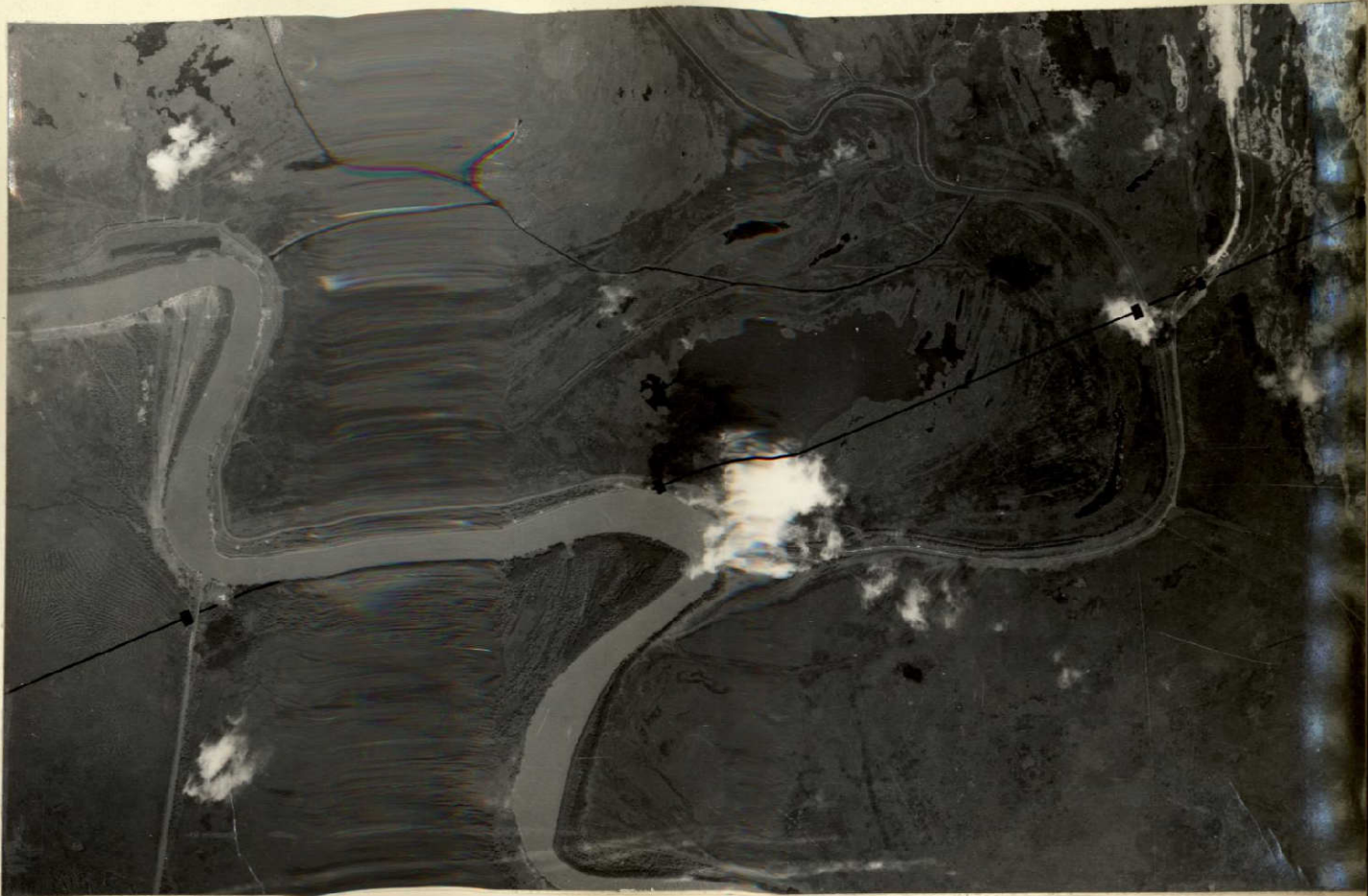


Fig.16 **The** great profile **recorded** aerophotographically

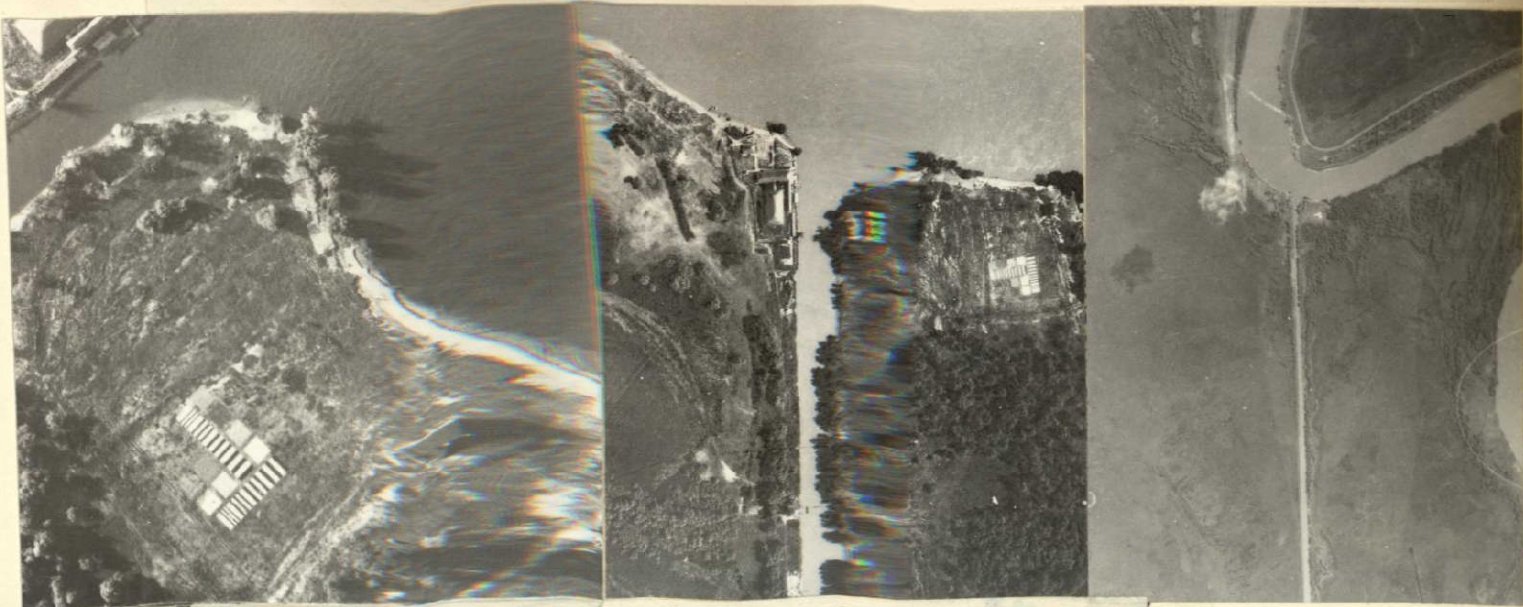


Fig.19 Stepwise deter**minations**

TEST SITE D E L T A

Location of test-site (latitude, longitude, topographic description)	Parameters to be measured on the test-site	Specific measurement method	Time and frequency of data collecting	Correlation between test-site measure- ments and airborne- space recordings
45° 01' 05" North 29° 16' 30" East On the Sf.Gheorghe Arm, in the Danube Delta, at km 54 - the residence of the field lab. The extensive test-site covers the whole Danu- be Delta, the Razelm- Sinoc lagoon complex and the continental platform, according to the enclosed sketches and boards-diagrams (see recapitulative report).	Measurements having a gene- rel character	Automatic meteo sta- tion, automatic unit for temperature mea- surements; synopti- cal maps, ephemerides tables, diagrams thermovision AGA re- cordings, Nimbus & Meteor recordings; densitometerings with MTF and OTF measurements; Secchi disks, laboratory determinations, deuterium contents, biomass, ph, salinity, etc.; thematical maps, topographical maps, photomaps, aerial photographies.	According to the phenological ca- lender in func- tion of vegeta- tion stages; -During high and low water level; -In winter-spring; -According to data handling plan (see appendix 5)	Measurement sets performed preceding the starting off of the program, simultaneously to airborne and space recordings, respecti- vely after these recordings (accor- ding to the data handling plan - see appendix 5).

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Fig. 18

TEST SITE B A R A G A N

Location of test-site (latitude, longitude, topographic description)	Parameters to be measured on the test-site	Specific measurement method	Time and frequency of data collecting	Correlation bet- ween test-site mea- surements and air- borne-space recor- dings
45° 16' 10" North 27° 54' 40" East Cazasu - Brăila is the residence of the inten- sive test-site; Extensive test-site covers the Terasa Brăilei and Insula Mare a Brăilei reclamation system; The eastern part of the Bărăgan (Terasa Brăilei) is a loess plain, res- pectively Insula Mare a Brăilei is an irrigated meadow.	Specific measu- rements for soil-vegetation and agrohydro- geology res- pectively	Meteo station; Hydrogeologic sta- tion; Ephemerides, tables, diagrams, synopti- cal maps, thematical maps, photomaps; Meteor & Nimbus re- cordings; Soil chemism humi- dity; Temperature measu- rements, spectrora- diometrical measure- ments, thermovision recordings; Biomass.	According to the phenological calen- der in function of vegetation stages; -During high and low water level; -In winter-spring; -According to data handling plan (see appendix 5)	Measurement sets performed preceding the starting off of the program, si- multaneously to airborne and space recordings, respec- tively after these recordings (accor- ding to the data handling plan - see appendix 5)

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*Harta zonelor experimentale
-situri test-pentru teledetectie*



Fig.20 The general situation of the test-sites

Brațul Sf Gheorghe

Teritoriul Ocrotit Silvic

0 100 200

- 37 -

Fig.22

P E V I S T

Design and achievement of a system software for processing of the Landsat video data.

The PEVIST system is characterized by:

- a large register of possibilities;
- modularity and extensibility;
- simplicity and elasticity in exploitation.

It contains some subprograms and a main program coordinating them. The subprograms are divided into two groups:

- A. Service subprograms;
- B. Subprograms accomplishing different tasks of interpretation and complex display of output data.

A. Service subprograms:

- ANPET - printout of the ID and Annotation records of the CCT
- POZBND - positioning of the magnetic tape
- CITBND - reading the desired video data record (a strip of a scan line)
- FISDIS - transcription of data from a CCT on a disc
- DESCIF - conversion of the interleaved video data to spectral band organized form
- EDTACT - active printout of level lines, considering the extreme values, using, as desired, both linear and logarithmic scales
- MRCABS - horizontal marking of listings
- EDTLIN - printout of a conventional marked listing line
- EDTTAB - printout of value tables representing grey levels or frequencies

B. Subprograms accomplishing different tasks of interpretation and complex display of output data:

- DSLINS - densitometering along scan lines, with the possibility of superposing 2, 3 or 4 spectral bands
- DPRFLS - densitometering on shapes intersecting the scan lines, with the superposition of 2, 3 or 4 spectral bands
- CNTRST - setting up of "contrasted scan lines" by means of various algebraic combinations of the original ones
- EDTHRT - printout of maps representing equidensitometry, strip and threshold filtering
- DISTR1 - histogram of grey levels distribution in a single spectral band using as desired both of scales: linear and logarithmic
- DISTR2 - histogram of grey levels 2-dimensional distribution (simultaneous analysis in two spectral bands) using as desired both scales: linear and logarithmic
- DISTR3 - histogram of the gray levels 3-dimensional distribution (simultaneous analysis in three spectral bands) using as desired both scales: linear and logarithmic
- INSTRV - training for the maximum likelihood decision rule
- CLASV - classification using the maximum likelihood decision rule
- INSTRD - training for the minimum distance decision rule
- CLASD - classification using the minimum distance decision rule
- CLUSTR - identification of phenomena (clustering).

Fig.23

Analogical-digital and digital-analogical conversion
unit video data signals using television - PRIM R-01

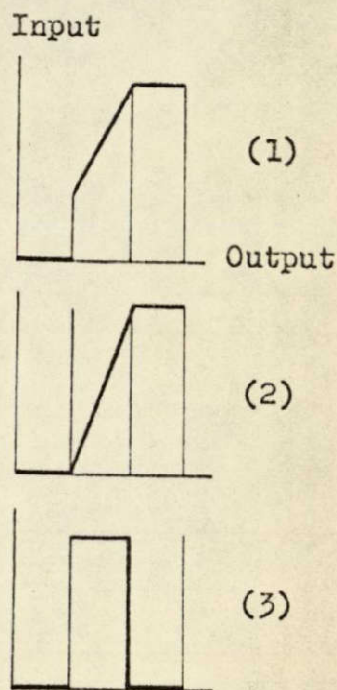
Starting from an existing video-
phone unit, we have achieved the
adaptation of the video data sig-
nals processing in 3 variants,
corresponding to:

- (1) band - filtering;
- (2) edge - filtering;
- (3) equidensitometry-enhancement;

The unit may be used both for
processing photoimages and for
direct recording of natural scenes.

In spite of the limitations of the
television systems, the results of
the video signal processing are
very suggestive.

The unit was conceived to perform
preprocessing, followed by CCTs
computer processing.



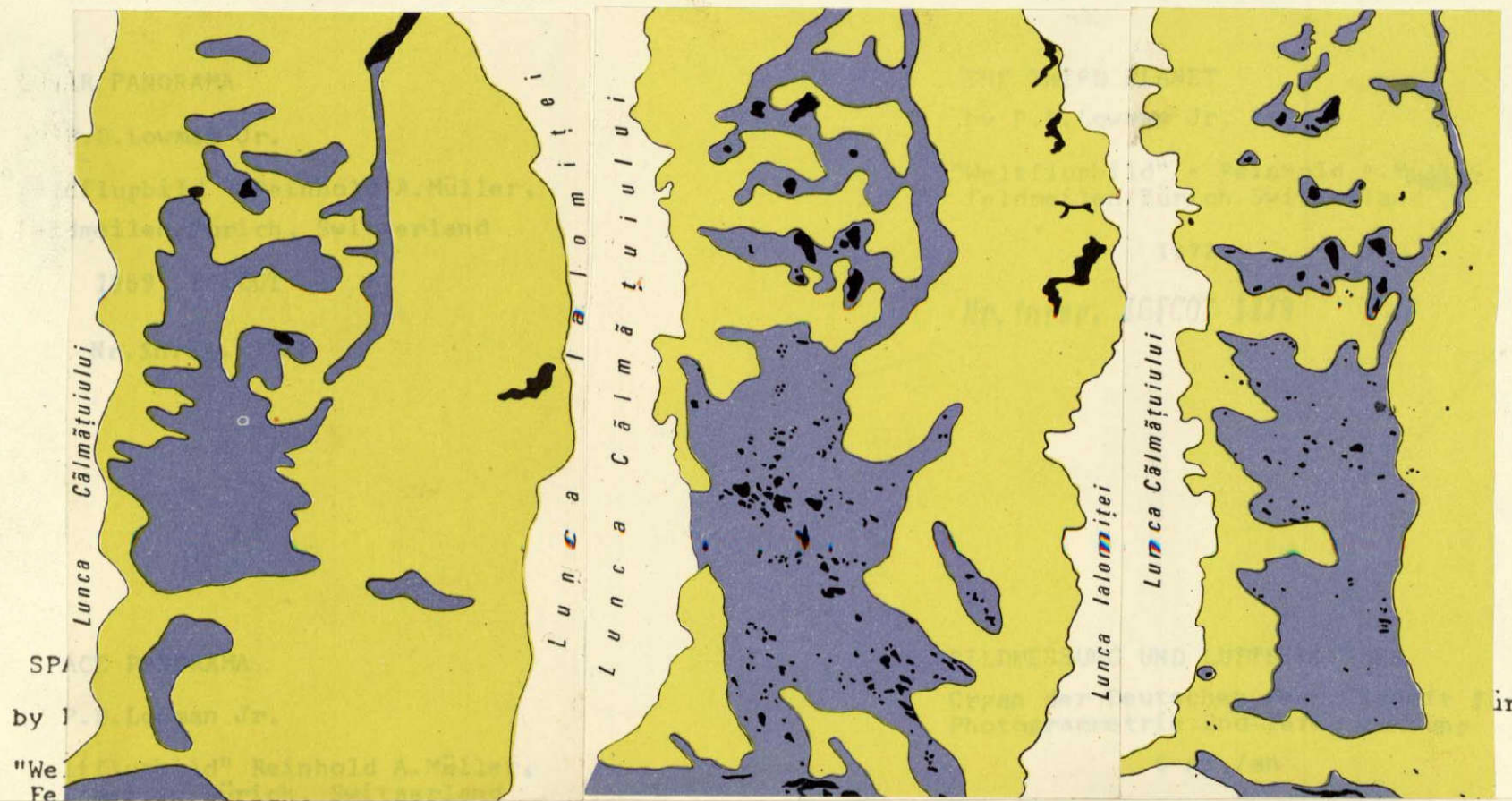
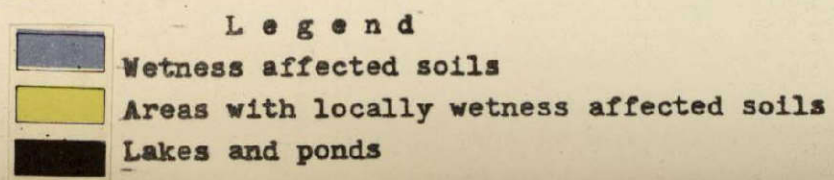
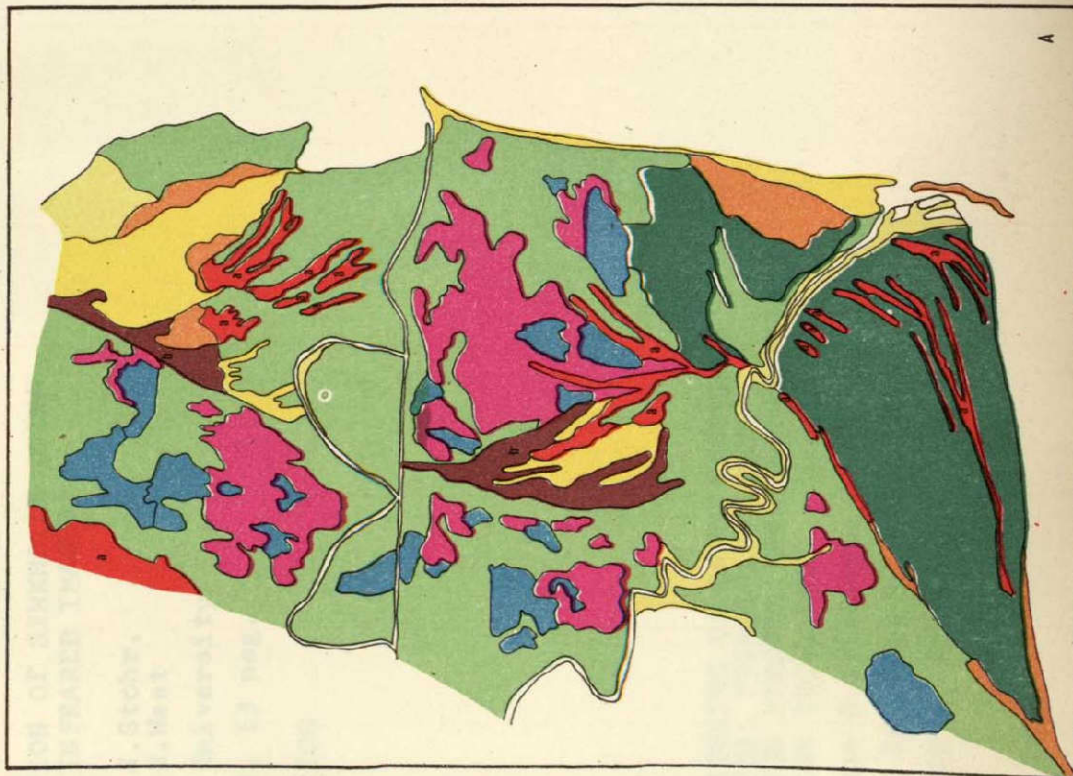
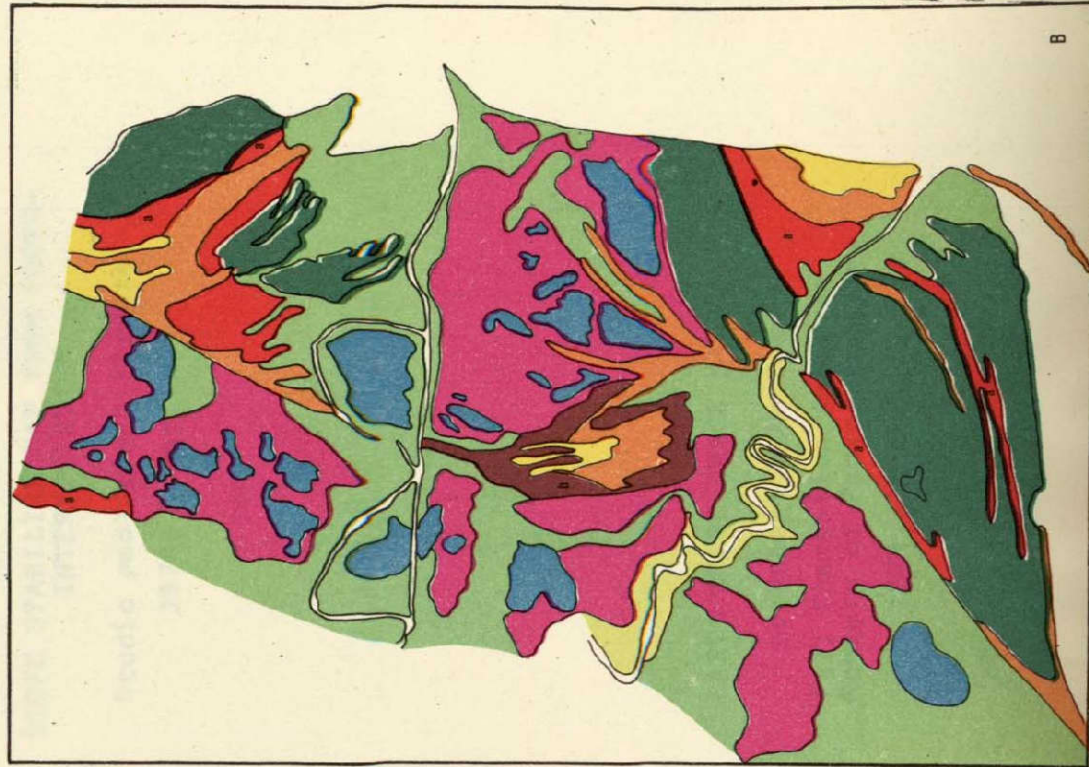


Fig.24 The evolution of the phenomenon of humidity excess surveyed on: (a) 1968 conventional thematic map (scale 1:500,000); (b) Landsat recording of June,2,1975; (c) Landsat recording of April,3,1976





Legend

- Alluvial soils
- Marine sands
- Marine sands, saline soils and humic gley soils
- Saline soils, bog soils, locally marine sands
- Humic gley and low humic gley soils
- Swamps, saline soils and humic gley soils
- Bog soils and peaty soils
- Peaty soils
- Lakes

Fig.25 Interpretation of Landsat recording (band 7) for soil inventory in the eastern part of the Danube Delta: 20-50% qualitative improvements have been obtained in comparison with data on conventional map

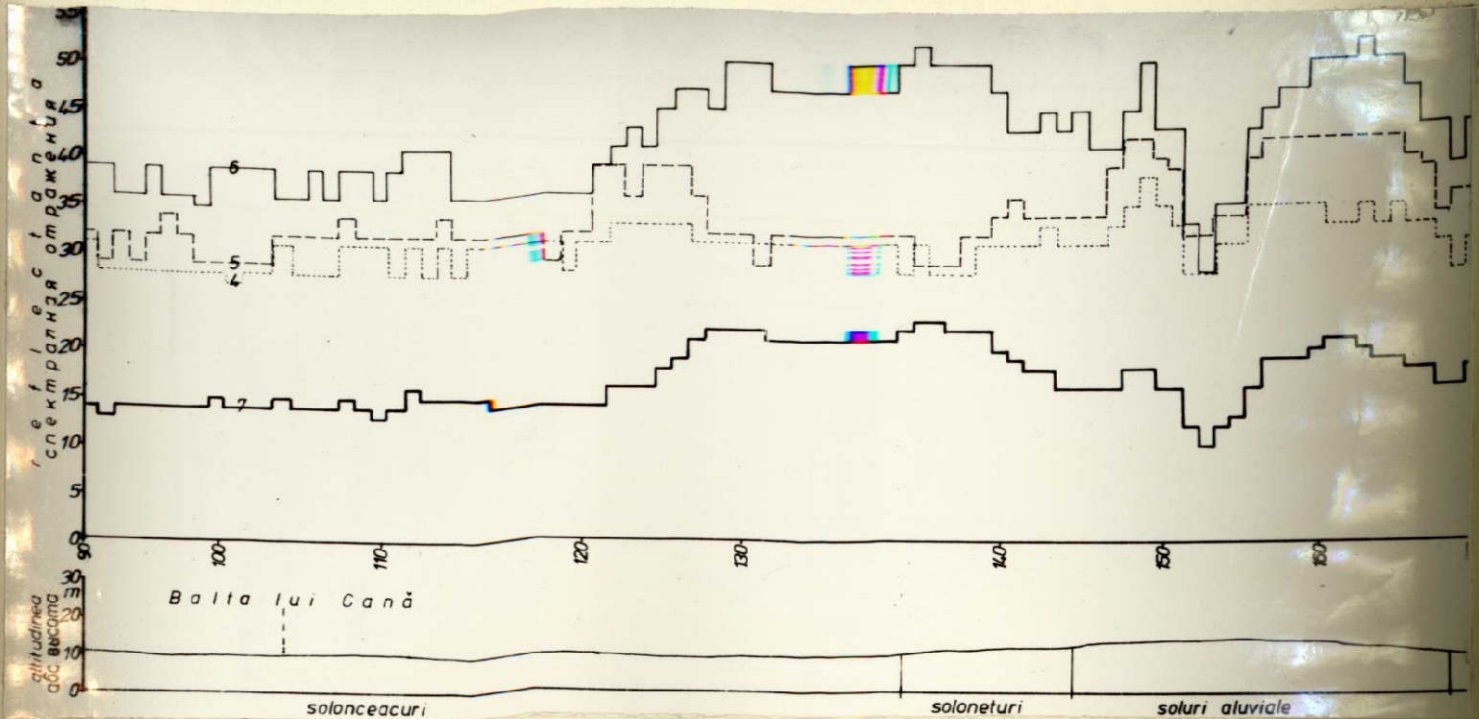


Fig.26 Densitometering Profiles along scan lines in 4 spectral bands, correlated with Soil-relief

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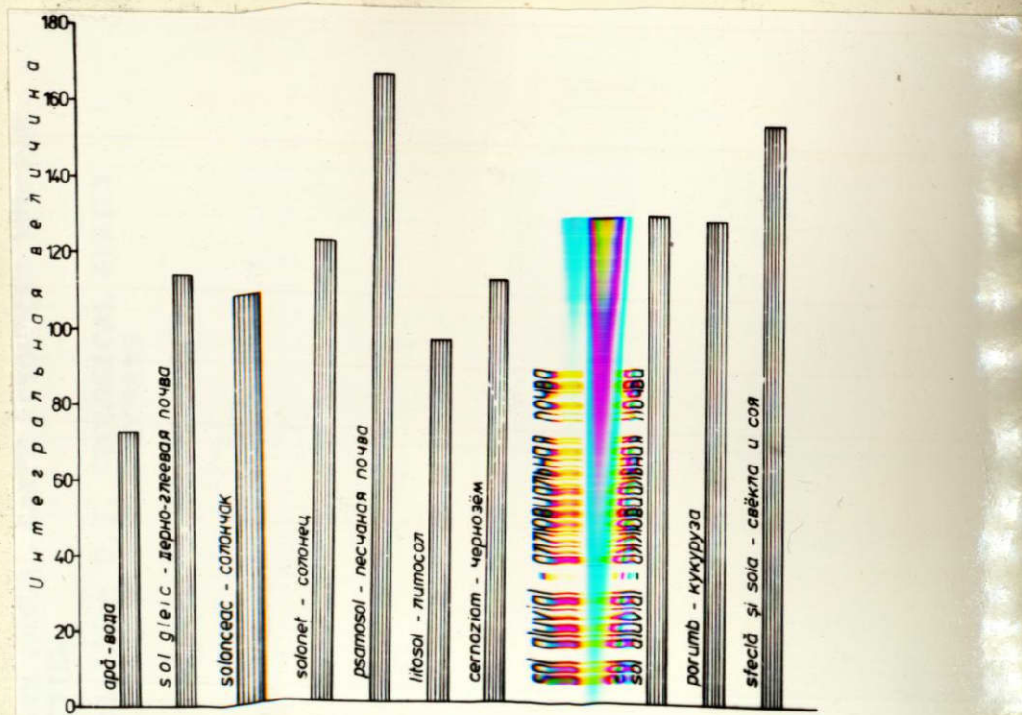


Fig.27 Reflectance values in the four MSS

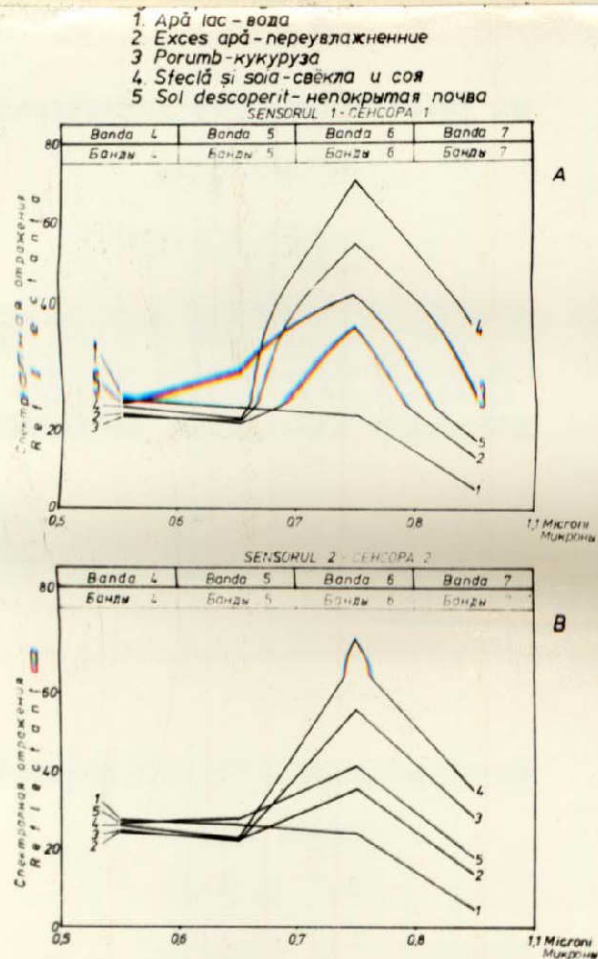


Fig.28 Spectral analysis of the agricultural area

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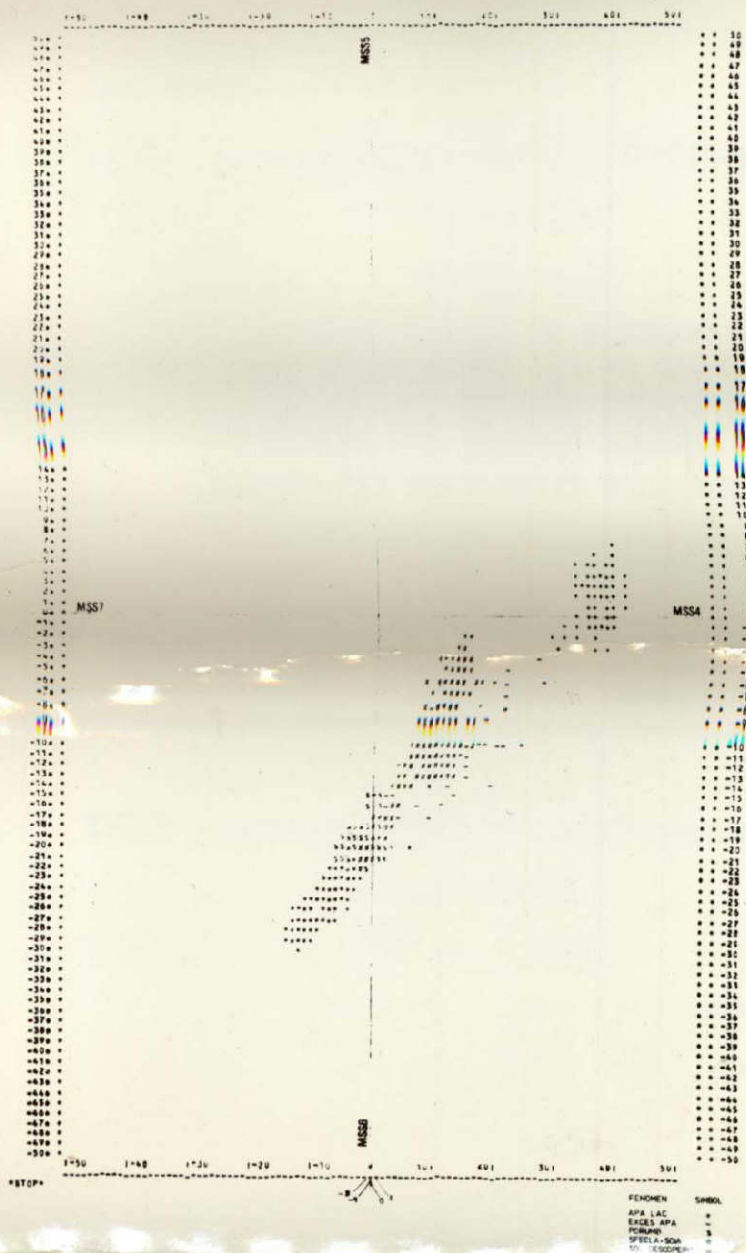


Fig.29 Clustering analysis in the four MSS

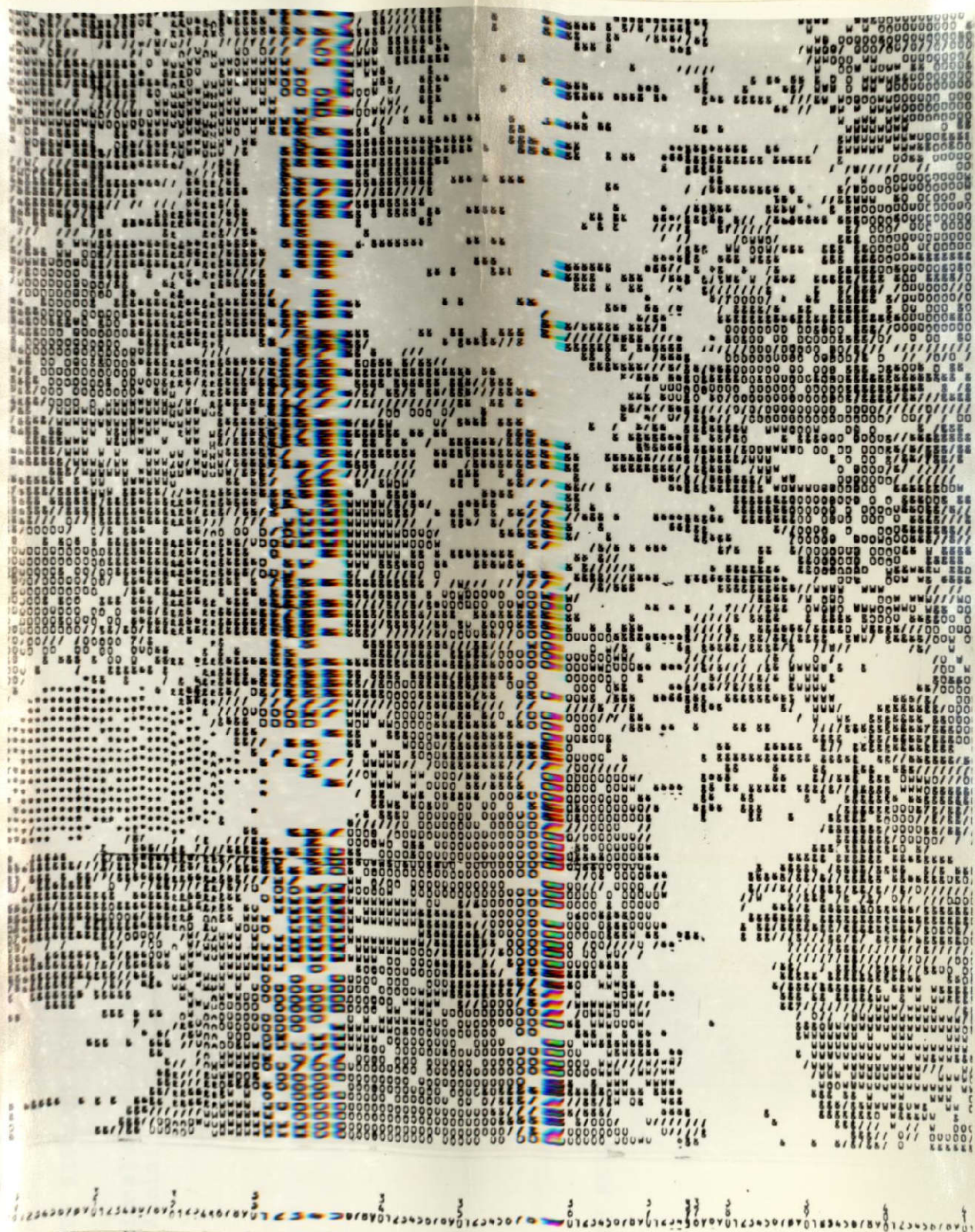


Fig. 30 Computer implemented classification of Landsat digital data; level II identification

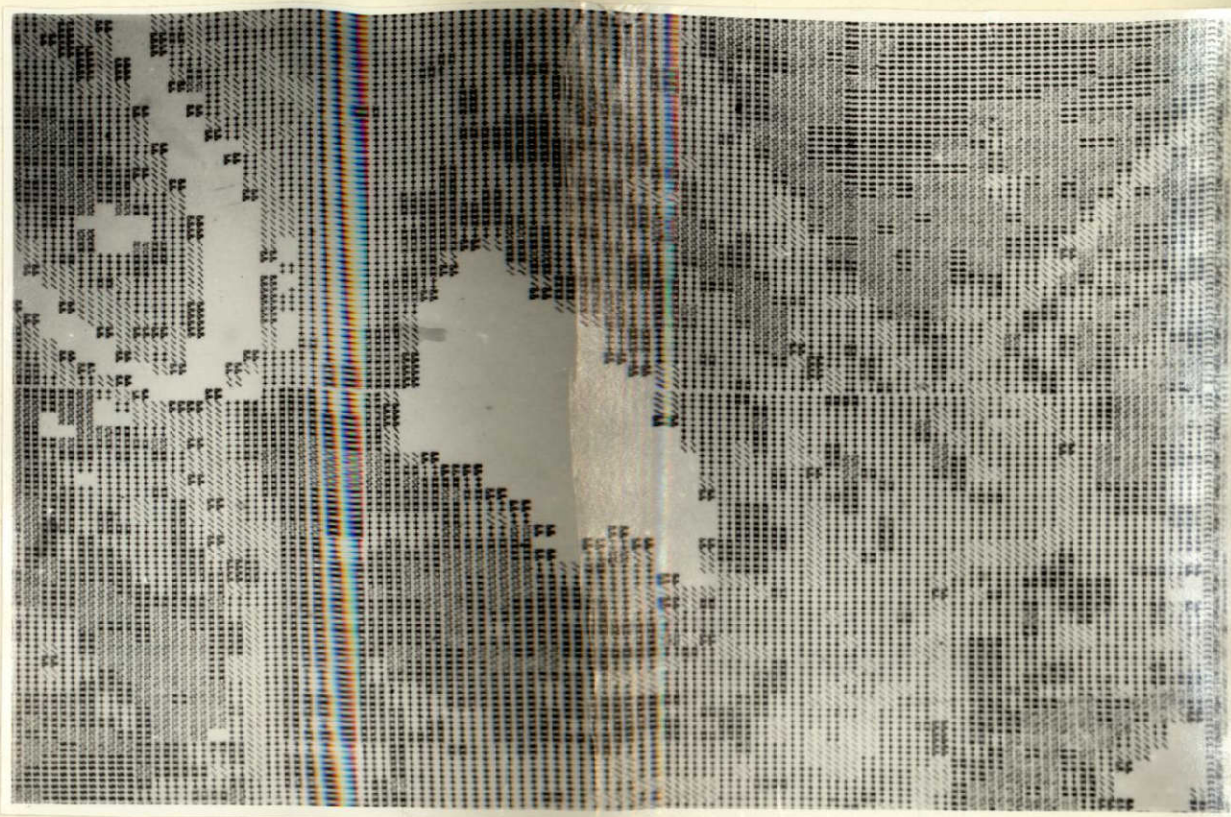


Fig. 30,a Automatic thematic mapping

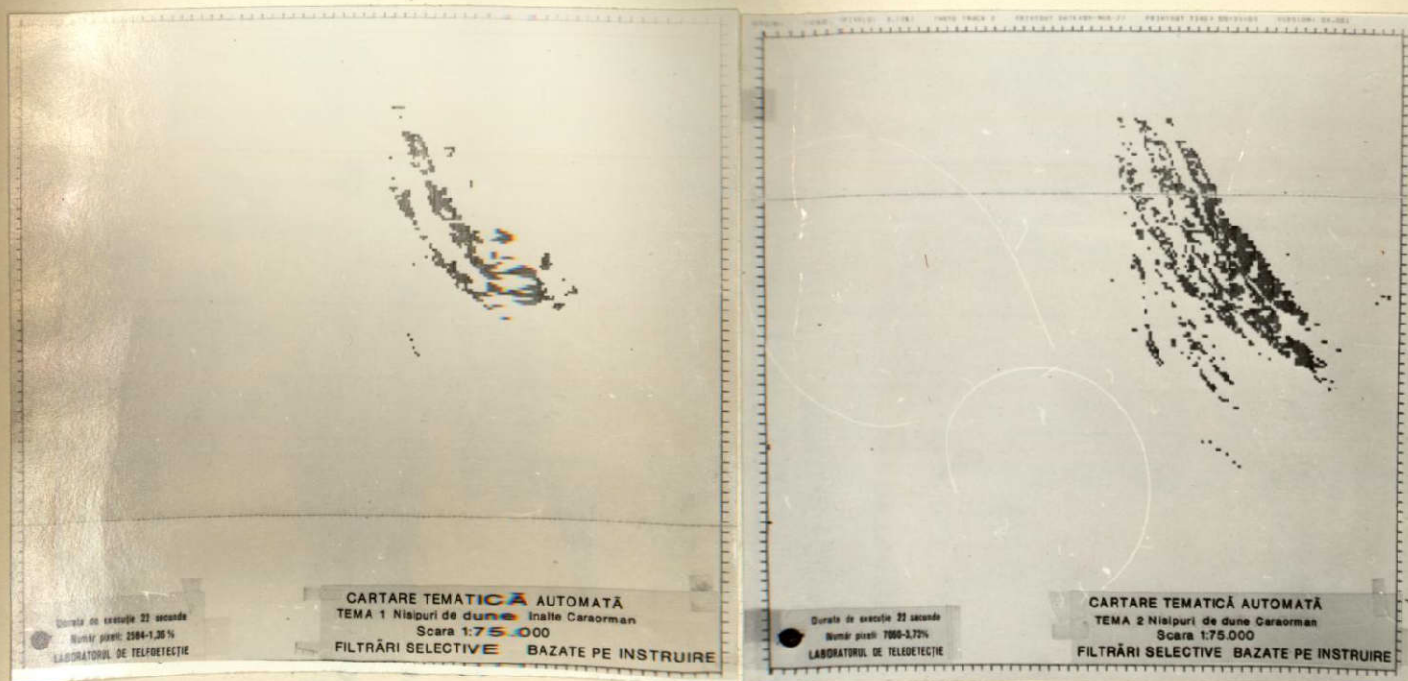
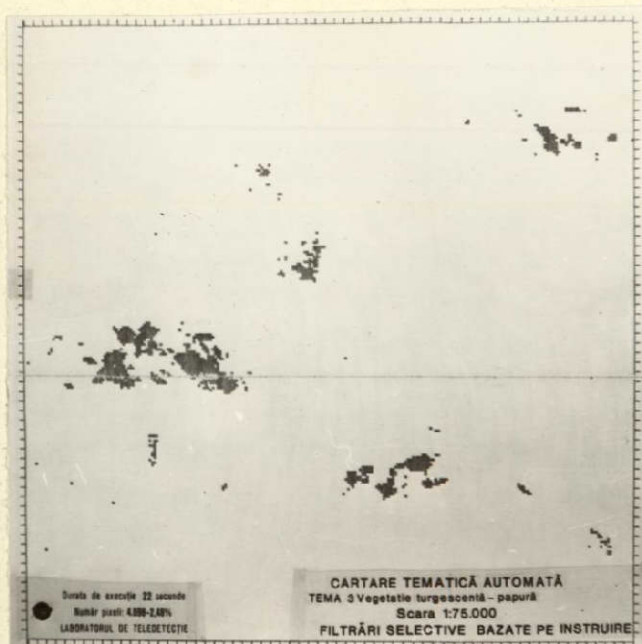


Fig. 30,b,c - Thematic mapping at Image 100 obtained in several variants-
for different themes unsupervised:
a - theme track 1 - bright sand; b - theme track 2 - sand

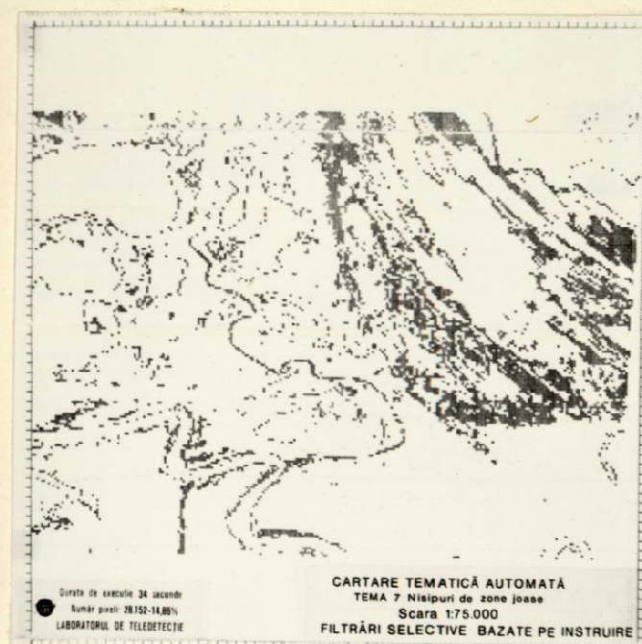
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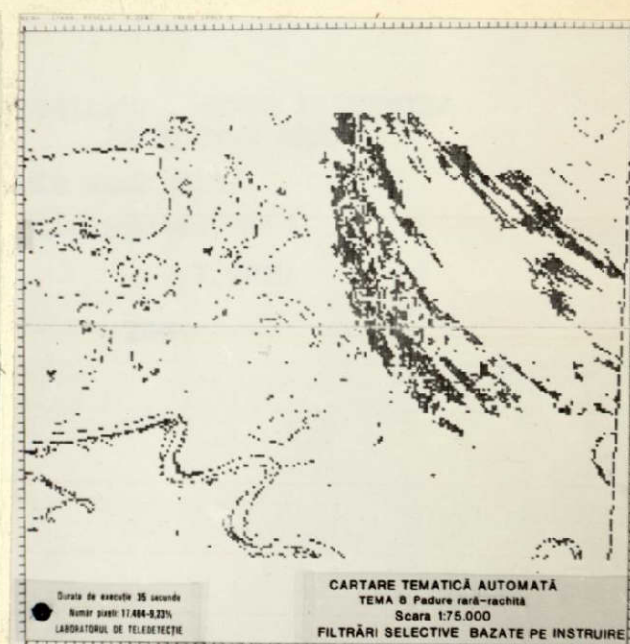
(d)



(e)



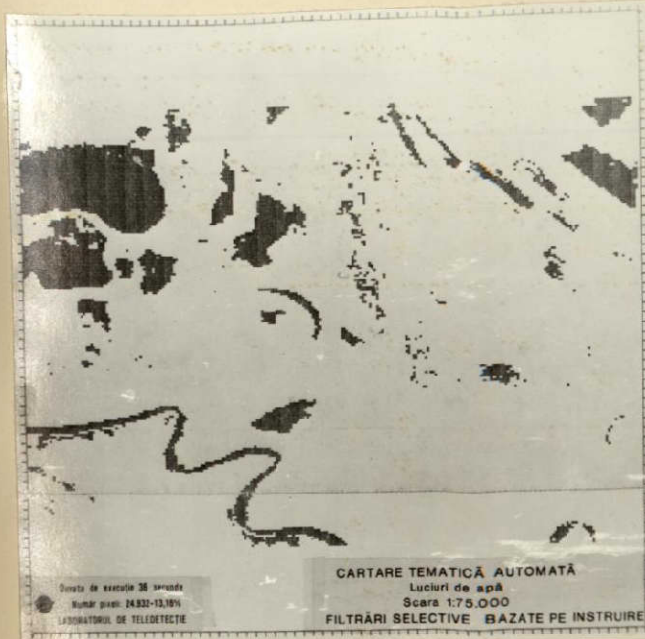
(f)



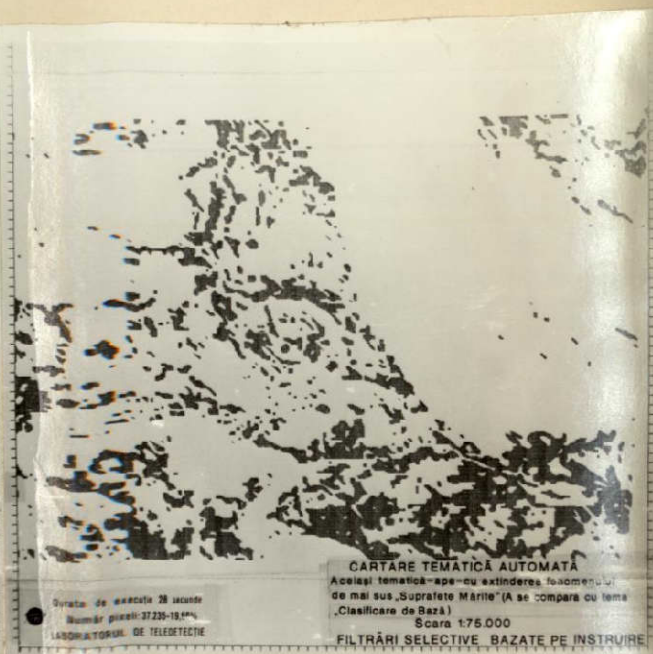
(g)

Fig. 30, d, e, f, g Thematic mapping at Image 100 obtained in several variants - for different themes unsupervised;
 d - theme track 3 - vegetation 1; e - theme track 4 - vegetation 2; f - theme track 5 - vegetation 3; g - theme track 6 - vegetation 4

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(h)



(i)



(j)



(k)

Fig. 30, h, i, j, k

Thematic mapping at Image 100 obtained in several variants - for different themes unsupervised:
h - theme track 7 - water; i - theme track 8 - regions grown; j - theme track 1 - original classification; k - theme track 2 - isolated pixels removed



(l)



(m)



(n)



(o)

Fig. 30, l, m, n, o Thematic mapping at Image 100 obtained in several variants - for different themes unsupervised;
l - theme track 3 - surrounded pixels included;
m - theme track 4 - outlines; n - theme track 5 - water bodies; o - theme track 6 - water

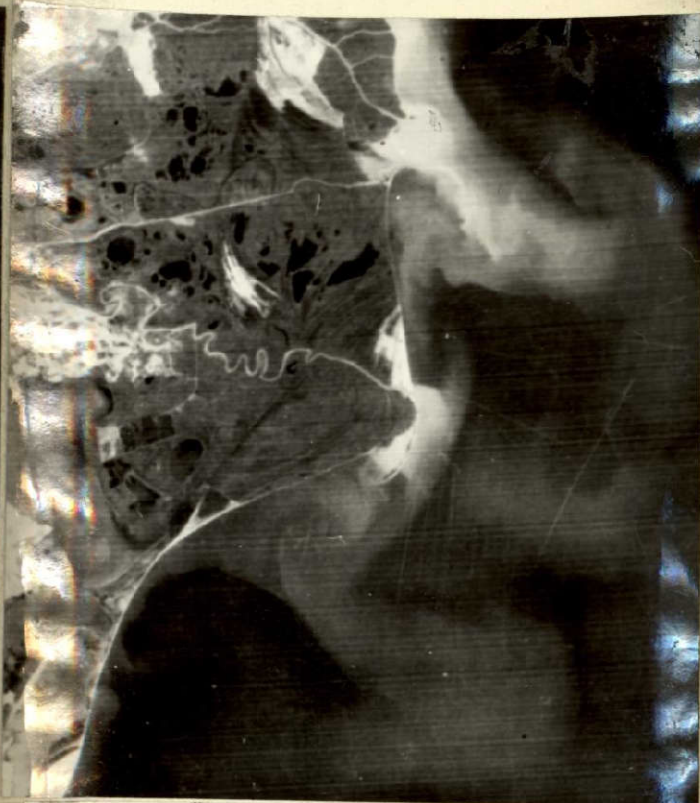


Fig. 31 The distribution of alluvial deposits concentration using relative indices of density, qualitative determinations, on the recording of the 24-th, July, 1975 - band 5

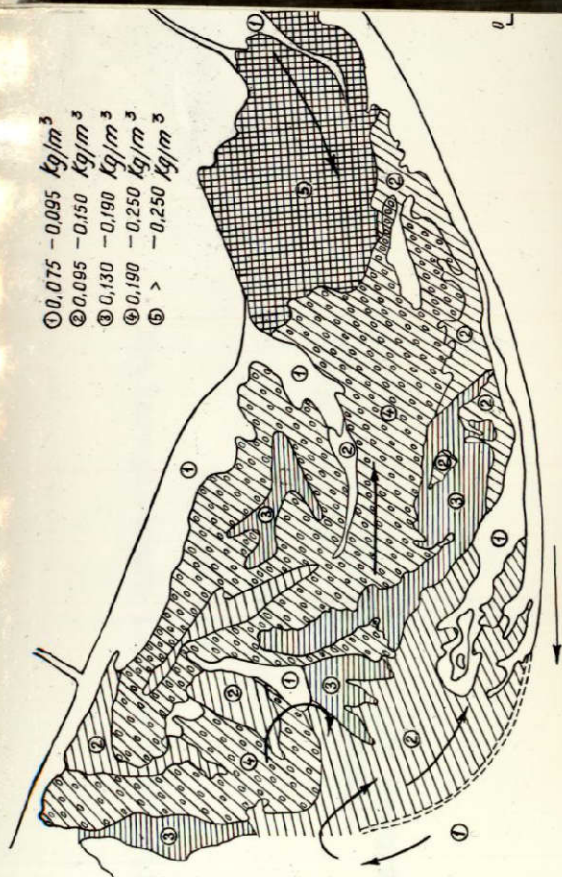


Fig. 32 The same distribution followed in the sampling area by means of airphotos and field determinations

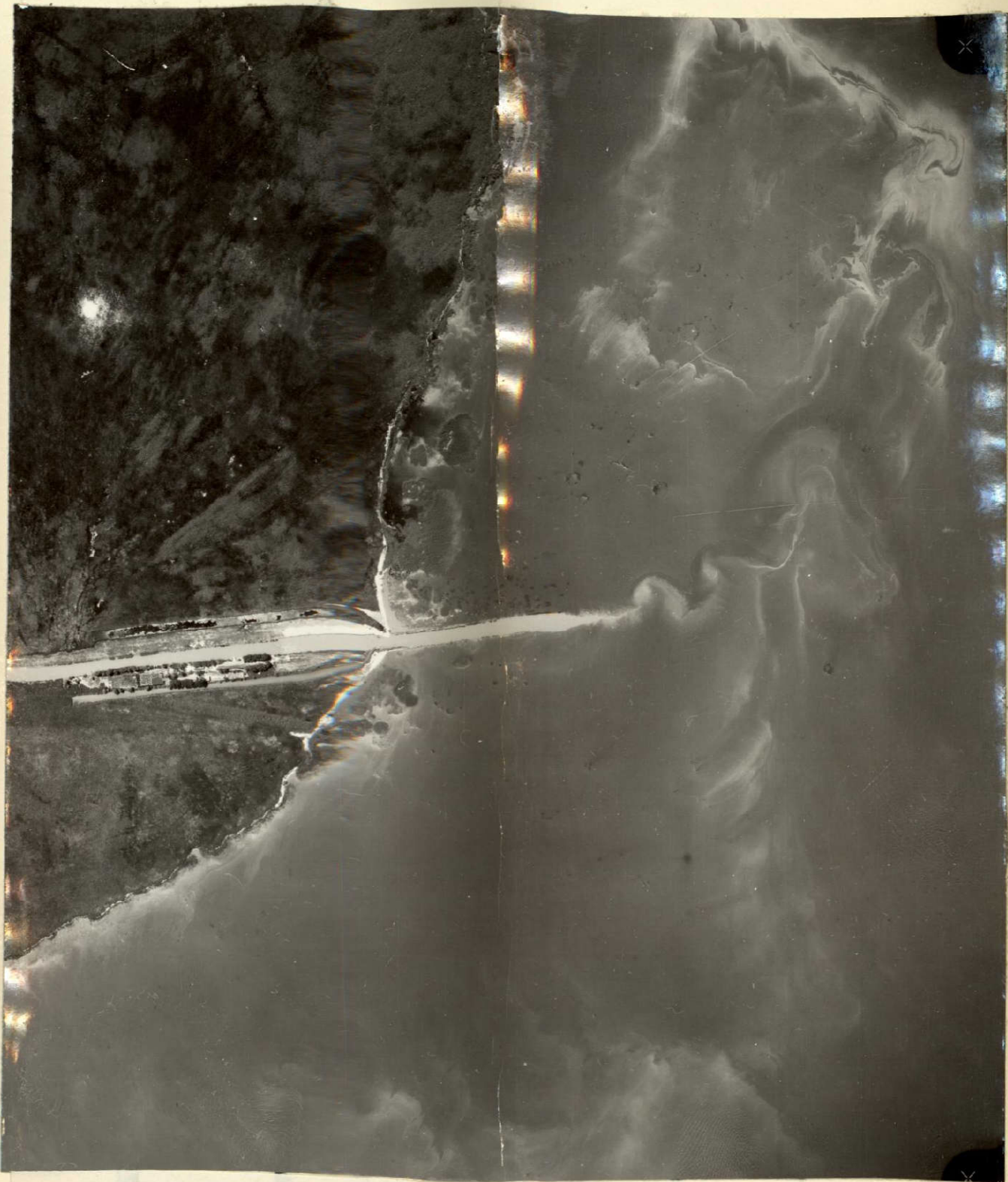


Fig.33 A detailed sample achieved for inland lakes



Fig. 35 Biological pollution occurred in cold season (Landsat data 26.02.1975, bands 4 and 5)

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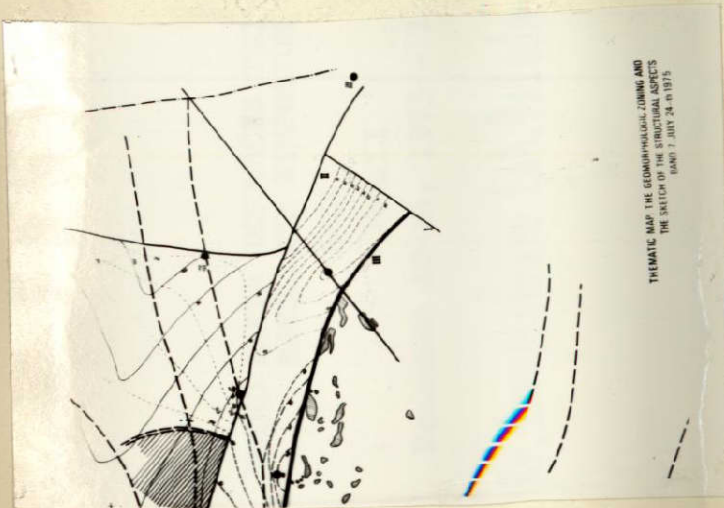


Fig. 36 The recording show the successive stages of the evolution
of the Danube Delta, clearly marking the separation of the
Fig. 37 fluvial delta from the marine delta; thematic mapping on
the basis of MSS

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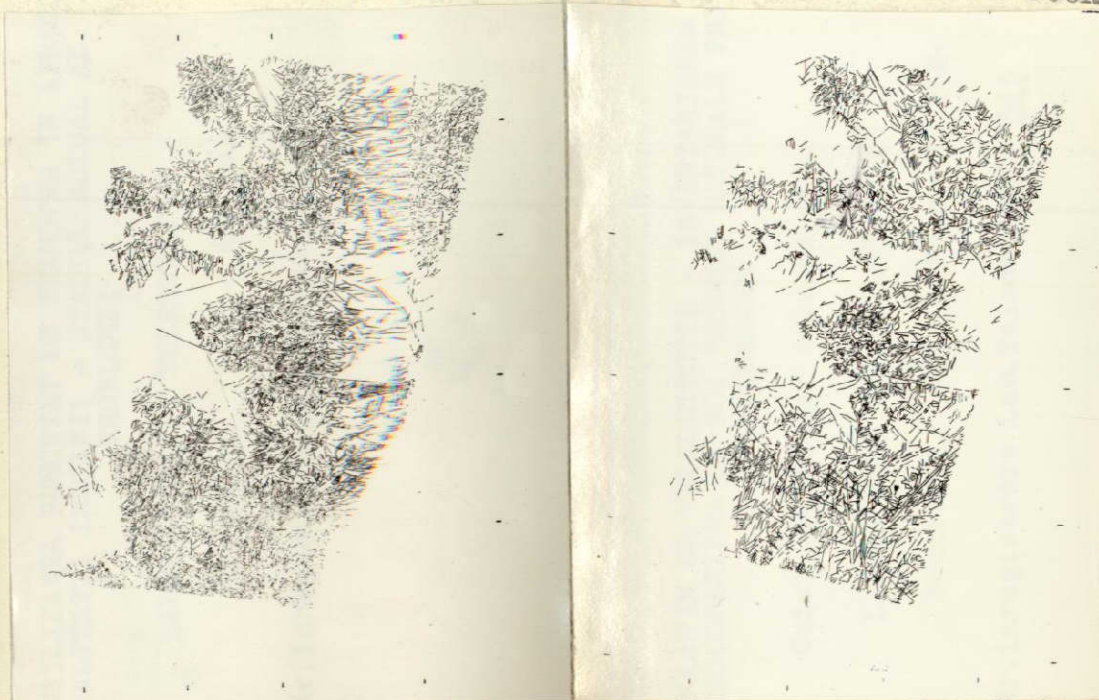


Fig.38 The maps of lineation distribution obtained on the basis of criteria applied independently by two researchers, on the same Landsat data

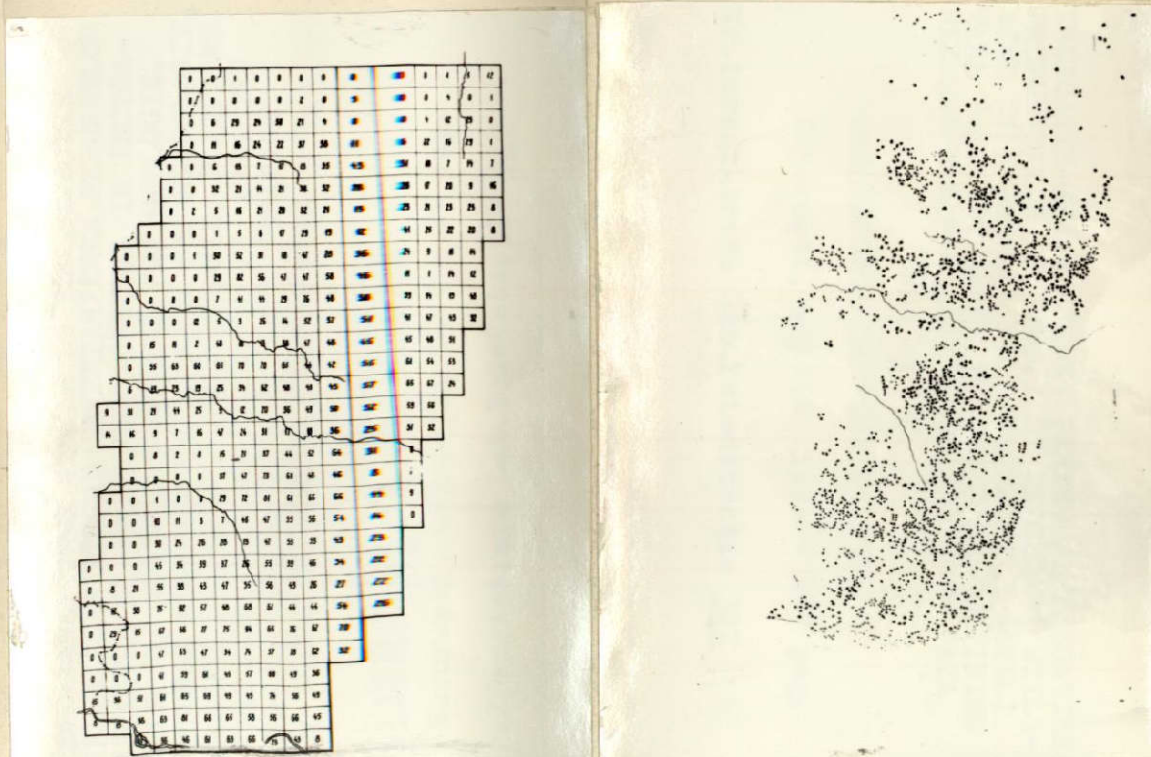


Fig.39 The maps of lineation field distribution manually digitized

Fig.40 The distribution manually digitized of the intersection points



Fig. 41 Equal density curves

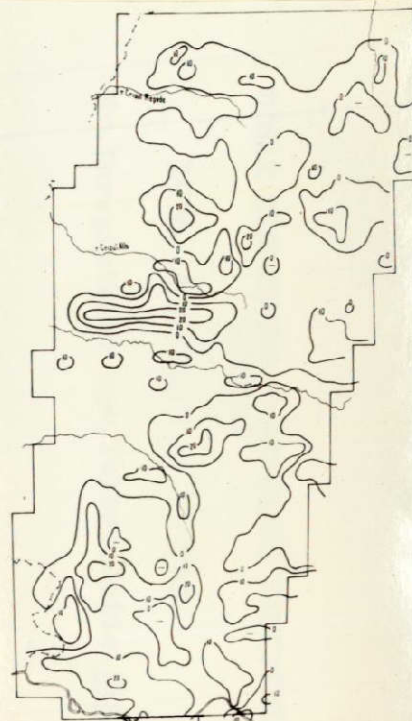


Fig. 42 Residual map of lineament, obtained by Fourier frequency filtration

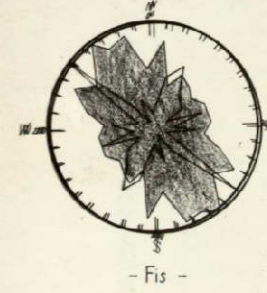
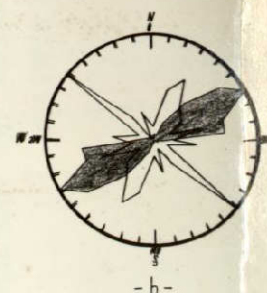
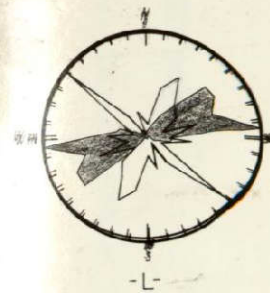
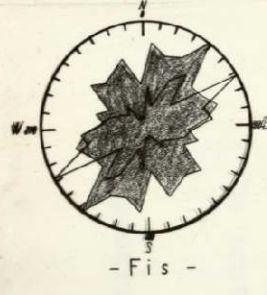
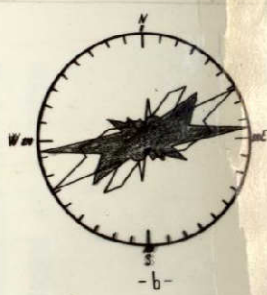
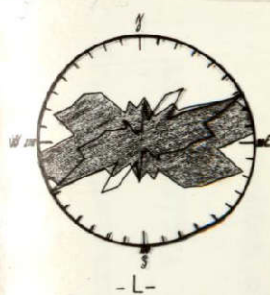


Fig. 43, 44 Statistical analysis of the whole lineaments field, considering the lineament direction and tendencies, based on the satellite recordings (free diagram) superposed over the respective diagram made up after geological field data (hatched):

- top - hercinic crystalline belt

Appendix 1

List of publications, documentation a.s.o. we are
in need of:

1. "The Sixth Line Stripping" phenomenon is particularly visible, especially on band 4 - we should be interested in knowing the practical possibilities methods; we realize the processing according to group of sensors or individual sensors (as in some cases the difference is quite great);
2. We should to carry out a number of initial processings on our own materials (data);
3. We are interested in the practical experience gained in relation with the digital corrections, respectively the. analogical ones, applied to the recordings; especially we are interested in the technique for correcting Landsat data for solar and atmospheric effects;
4. We should like to get copies from the software operatively used in the processing of the remote sensing recordings; we wish to join exchange of experience system in order to benefit from the programs that are to be conceived further;
5. We wish to obtain copies from the instructions of field and lab works within co-operation programs on precise themes so as, possible to apply them experimentally with communication of the obtained results;
6. We would like you to lend us the documentary film: "Mission 73", "HQ 171 - The Wet Look", "HQ 276 - Pollution";
7. We wish to utilize and turn to good account our very appropriate possibilities to carry out intensive, detailed and sophisticated field investigations with a view to correlate them to other partners' possibilities in order to thoroughly analyze the complex space recordings (marine, land, coastal and wet areas, oceanography, etc.) as well as to perform various themes having high accuracy;
8. Operative exchanges amongs investigators working on themes similar as subject, respectively area (for example Mississippi Delta and Danube Delta).

Response to the NASA applications notice - AN-OA-76-B

- a. A statement of the nature of our interest in Landsat-C data with a description of the projected work to be performed:
- We are directly interested in continuing and developing our research work within the Landsat 1-2 programs as well as for operational works in the following directions: (1) remote sensing technologies in various structures and variants; (2) applications in agriculture-especially crop forecasting, survey and monitoring of the land fund quality; attempts at separating within the surveying-monitoring: soil humidity excess, salinization, alluviation, attempts at surveying-monitoring the vigour of vegetation, at tracing pests; (3) utilisations in water resources-inland lakes and oceanography, continental platforms and deltaic zones, including the surveying-monitoring control of water quality; attempts at separating turbidity due to suspensions of alluvial type from those of "red blossoming" type (during warm periods), respectively diatoms (during cold periods) (4) geology, hydrogeology, thermal water sources, geologic hazards;
- According to the above mentioned, we benefit from specialized working teams who co-operate on a multi and interdisciplinary basis for developing researches, in each of the four main directions previously mentioned; we also possess a certain background material base and we have started staff training and specialization as well. All this was and is mentioned in the quarterly NASA type report which we send regularly as well as in the present recapitulative report.
- b. An estimate of Landsat-C coverage requirements such as geographical areas, time periods, frequency of coverage and cloud cover
- The area to be covered: the whole country, including the continental platform of the Black Sea, that is in the present index system - see section 2.0 - test-site requirements, proposed investigation "Multidisciplinary study with Landsat data in the lower basin of Danube and Danube Delta".
- The period: seasonal (for each season) at least once in all bands and possibilities, in the active period of vegetation, from the 15-th April to the 1-st September, the frequency even denser, in the peak period even every 3-5 days; in all cases

maximum cloud coverage 50%.

In connection with those we must mention that:

- It would be particularly useful to have the possibility of ordering the data operatively according to the characteristic situation between 6 months and 5 days in advance; in the catastrophic situations it would be useful that this ordering should be placed 1-2 days in advance;

- Likewise as was mentioned in the answers given to NASA questionnaires and in the quarterly reports, a shifting of the recording hour would be necessary, as at present this hour is too early especially in autumn and winter.

c. An indication of sensor requirements such as all bands of MSS, thermal or visible band data only, daytime versus nighttime coverage, frequency of RBV coverage required relative to MSS coverage, etc.:

- RBV data quarterly necessary in order to achieve a system of initial reference and of registration between RBV data and standard maps and then between the successive recordings. We intend to operate at the scales 1:200,000; 1:100,000 and 1:25,000 to cover the needs of different users;

- MSS data - bands 4,5,6,7,8 are necessary: in winter a coverage, in spring 2, in summer 5, in autumn 1. The recordings on band 8 are necessary both in the day time and at night.

We need repetivities in order to monitor the vigour of vegetation, the watering norm and pollution.

d. An estimate of the type and amount of data required:

- Our option is for resampling data by cubic convolution finalized in USPA which resembles our Gauss projection.

- Product number 1 - 241 mm MSS bands 4,5,6,7,8 B/W negative, 1:1,000,000 scale, geometrically and radiometrically corrected film product - total quantity 2,000;

- Product number 3, subscene A,B,C,D B/W negative, 1:500,000 scale, geometrically and radiometrically corrected film product; total quantity 500;

- Product number 5 - color transparencies - total quantity 60;

- Product number 7 - CCT, 9 track, 1600 BPI, geometrically and radiometrically corrected - total quantity 500;

- 16 mm microfilm, catalogs accession aids - product number 9.

Appendix

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1. Preliminary word	pg.	1
2. Research theme in cooperation with NASA: "Use of ERTS for Resources Investigations in the Lower Basin of the Danube and the Danube Delta"		2
3. The situation of the recordings received on 27 th October 1975, within the cooperation with NASA and the distribution of the copies of those recordings to those included in the remote sensing programme		17
4. The evidence of the recordings announced as having been already sent by NASA and which will be received within the shortest time		17
5. The evidence of the recordings ordered within the cooperation and which will be received within a short time		17
6. Magnetic tapes sets ordered at NASA within the cooperation and which are to be received in a short time		18
7. Map with the evidence of the recordings of the above mentioned items 3-6		19
8. Acknowledgements, news, recent manifestation and respectively those which will take place in a short time		20
- Landsat News nr.3, May 1975		20
- Landsat News nr.4, August 1975		22
- Landsat News nr.5, October 1975		24
- Symposiums, conferences, national and international manifestations		27
9. Facilities offered by the Laboratory of remote sensing to those included in the remote sensing programme and to those interested		28
10. New publications received \		29
11. Publications of the remote sensing Laboratory published up to the present		29

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Remote Sensing Bulletin No.2 - December 1975

Summary

1. Present situation and development of remote sensing in the near future (till 1980) and in the prospect (till 2000-2010) pg. 1
2. The situation of the recordings received on 6th December 1975 within the cooperation with NASA and the distribution of the copies of those recordings to those included in the remote sensing programme 25
3. The evidence of the recordings announced as having been already sent by NASA and which will be received within the shortest time 25
4. The evidence of the recordings ordered within the cooperation and which will be received within a short time 25
5. Magnetic tapes sets ordered 25
6. Recapitulative situation of the existing Landsat recordings over the zone 26
7. The dates of Landsat 2 satellite passess for the period 1 May - 30 November 1976 27
8. Acknowledgements, news, recent manifestations and respectively those which will take place in a short time 28
9. Facilities offered by Laboratory of remote sensing to those included in the remote sensing programme and to those interested 32
10. New publications received 33
11. Type 1 report-progress report for period May-December 1975 "Use of Landsat data for natural resources investigation in the lower basin of the Danube and the Danube Delta" 35

Remote Sensing Bulletin No.3 - March 1976

Summary

1. The situation of the recordings received on 16th February 1976 and 18th March 1976 pg. 1
2. Magnetic tapes sets ordered and received 1
3. Recapitulative situation of the existing recordings: 2
 - 3.1. Erts-Landsat 1 recordings received as of slides 23x23 cm, white and black and respectively colour-composite

Appendix

- 3.2. Landsat 2 recordings received as negatives
7x7 cm, slides size 23x23 cm and copies on photo-
graphic paper 23x23 cm.
4. Acknowledgement, news, recent manifestations and respec-
tively those which will take place in a short time 4
5. New publications received 9
6. Type 1 report-progress for period January-March 1976
"Use of Landsat data for natural resources investiga-
tions in the lower basin of the Danube and the Danube
Delta" 11
7. Facilities offered by the Laboratory of remote sensing
to those included in the remote sensing programme and
to those interested 29

List of Report Worked out during 1975 by the collaborators
included in the programme "Inventory and discovery of new
resources through remote seinsing"

1. "Study on the use of the remote sensing in the research of
undergorund waters and the interpretation of airphoto and
the satellite recordings" - Phase 1975, 20 pages (Labora-
tory underground waters).
2. "The hydrothermic regime of the soil for the main crops in
the western and southern areas of the country", 82 pages
(Laboratory of agrometeorological research).
3. "Research by remote sensing concerning morphometric and dy-
namic charactersitics of the lakes and minor and major river
beds", 22 pages (Meteo and hydrological institute).
4. "Control of the water quality by remote sensing methods" -
Phase preliminary resport, 62 pages (Laboratory for water
quality).
5. "Contribution to the hydrogeologic study of the underground
waters in the Danube Delta and in the Black Sea area by remo-
te sensing method" - Phase 1: March 5th 1975; 2: June 10th 1975,
final delivery; December 20th 1975, 15 pages (Institute for
reclamation works).
6. "Digital processing of recordings obtained by remote sensing",
47 pages (Nuclear and electronic department):

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7. "Detector assembling, testing Si(Li) and cooled preamplifier and spectrometric chain variants (Nuclear and electronic department), 24 pages.
8. "Studies and trials on the recordings at medium-small height and of field - within remote sensing", 23 pages (Surveying and mapping institute).
9. "Research on remote sensing application under the geological condition in our country for the discovery and utilization of geothermal areas and for the prospecting of useful minerals", 19 pages (Laboratory of electrometric and geothermic research).
10. "Technology for processing the remote sensing recordings", 51 pages (Laboratory for remote sensing).

Appendix

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2. Sets of magnetic tapes, composite color and of photo- graphic materials, retrospectively ordered	1
3. Acknowledgements, news, recent manifestations and res- pectively those which will take place in a short time:	3
- Letter from Telespazio of April 14 1976	3
- NASA Newsletter No.8 of 1 April 1976	6
- NASA Newsletter No.9 of 1 June 1976	9
- WGA of 26 April; 10 May; 7 June; 14 June; 21 June 1976	14
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List of the NASA PI (principal investigators)
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2. Acknowledgement, news, recent manifestations and
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-NASA Landsat Newsletter nr.12, December 1, 1976	6
-Weekly Government abstracts, October 4, 1976	10
-Weekly Government abstracts, October 18, 1976	12
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- NASA Landsat newsletter No.1, January 29, 1975 . . .	3
- NASA Landsat newsletter No.2, March 28, 1975 . . .	5
- NASA Landsat newsletter No.13, February 1, 1975 . . .	8
- NASA Landsat newsletter No.14, April 1, 1975 . . .	12
- Remote sensing in Canada No.1, March, 1976 . . .	16
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- Bendix Down to Earth views, No.4/Spring, 1977 . . .	90
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- NTIS - Weekly government abstracts, April 11, 1977	10
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- NASA Landsat newsletter, no.16/1.08.1977	18
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- Remote sensing in Canada, no.5, July 1977	26
- NTIS - Weekly government abstracts, 11.07.1977	42
- NTIS - Weekly government abstracts, 8.08.1977	44
- NTIS - Weekly government abstracts, 29.08.1977	46
- NTIS - Weekly government abstracts, 12.09.1977	48
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- Rapport du seminaire des Nations Unites sur les applications de la télédétection, Bakou, URSS, 3-19 octobre, 1977	25
- International symposium "Image processing. Interactions with photogrammetry and remote sensing", Technical University Graz, 3-5 october 1977	38
- "Journées d'étude sur la télédétection, 15-17 novembre 1977, Institut National des Sciences Appliquées de Lyon	41
- NASA Landsat newsletter, nr.18/1.12.1977	42
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- Bendix - The earth resources, Down to Earth Views nr.5, autumn 1977	
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